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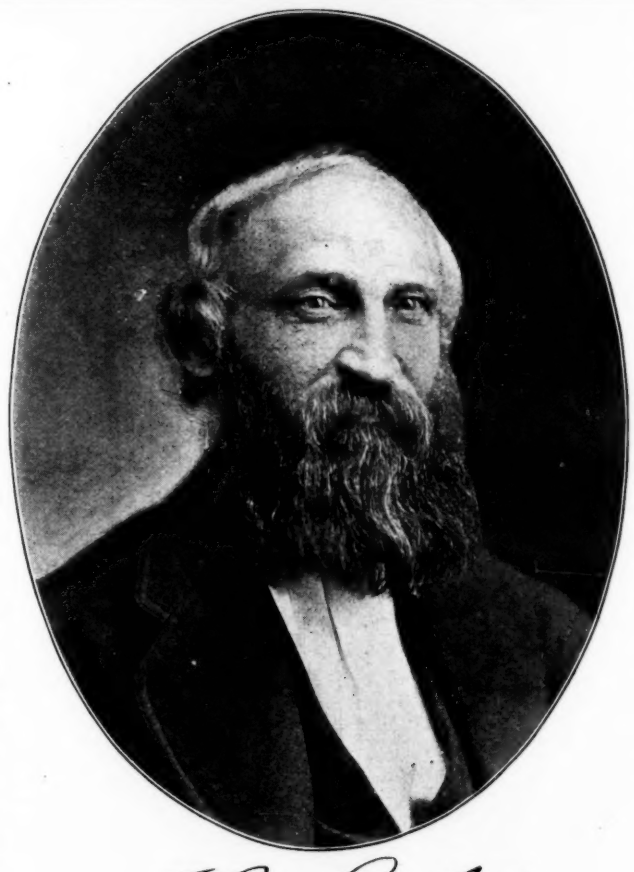
Frederick E. Sickels, Inventor.

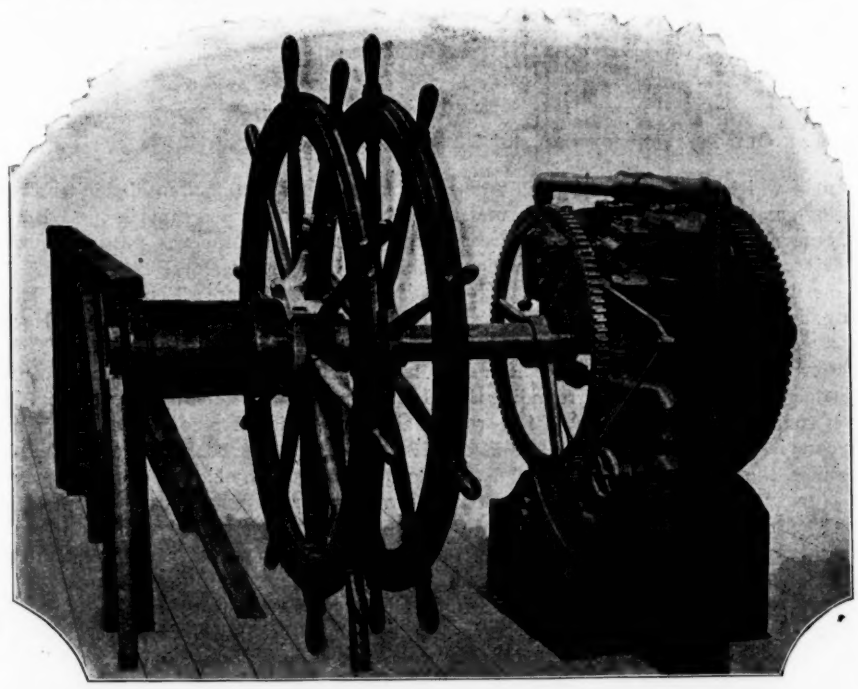
Frederick Elsworth Sickels was a descendant of Zacharias Sickles, from Vienna, Austria, who was brought to America in 1665, and was soon after attached to the garrison at Fort Orange. Johannus Sickels, supposed to be in the fourth generation of Zacharias, by his son Robert, settled at Bergen, N. J., and was married to Catharine Boquett, a Huguenot, by whom he had five sons and four daughters; he was a cloth merchant, in Maiden Lane, New York; wealthy, keeping a carriage and holding slaves, and is recorded as having invented a cloth-cutting machine of some description. John Sickels, second son of Johannus, married Hester Ann Elsworth, daughter of Frederick Elsworth, niece of Chief Justice Elsworth, and grandniece of the Earl of Shaftesbury, England. By her he had nine children, of whom Frederick Elsworth, born September 20, 1819, in Gloucester County, N. J., was the fourth child and third son.

John Sickels, father of Frederick, was a graduate of Columbia College, a fine linguist, a physician and surgeon, Chief Health Officer of New York City, scholarly, devoted to his profession, and wholly indifferent to the commercial and financial sides of life. Hester Ann, his wife, was a woman chiefly remarkable for her exalted religious ideas, inflexible course of life, and her affection for her family. Her devotion to religion was almost fanaticism, and her faith in the correctness of her own views amounted to an unquestioning, absolute certainty. John Sickels, with his scholarly professional man's indifference to the practical affairs of life outside of his own pursuits, and Hester Ann Elsworth, his wife, certain of the truth of her convictions, might well have given their son Frederick the hope, the faith, and the indifference to financial results which form the immovable basis of the true inventor's character. It would also seem almost a certainty that Frederick Elsworth Sickels should have been a scholar, as well as an inventor, as so many inventors are. Such was not the case. While a man of wide general information, and a most agreeable conversationalist with intimate friends, Frederick had little taste for books or for the pen. He wrote a clear, sloping hand, with well separated and distinctly formed letters, with many corrections and much interlining, and had a good vocabulary, but was not in any way a very notable writer. Nor was Frederick Sickels much of a draftsman. None of the shops where the most of his work was done can produce even a single sheet of his drawing, and diligent inquiry fails to disclose the existence at any time of drawings made by his hand. A single example of his workmanship, when he first went into the shop, is extremely well designed and executed (in brass) for a boy's production; it took the form of a present to his mother, a pie-crust crimper, and was the first production of his 'prentice days at the Allaire Works, in New York, where he began his life-work in machinery, sorely against the wishes of his family, in his seventeenth year. No reliable record of his early life has been found, nor are materials for a connected narrative of his life or labors at this



F. E. Sickels

time available. His personal papers cannot now be examined, and from his careless, unbusinesslike, unmethodical habits, and his aversion to writing and drawing, it is hardly probable that even if they were at hand they would afford any continuous history of his busy, troubled, unsuccessful life, marked by two brilliant and imperishable inventions, which will make his name forever famous in the history of steam engineering as the only man of all the great names since James Watt to add a radically new and important elemental idea to the theory of steam-valve action, and couple his new thought with mechanical details of such apt suitability as to bring it easily into the range of common practice. Frederick Sickels did do that. As James Watt left the steam engine it was perfect; it had all the elements which are used in the most advanced engines of to-day, except the one element added by Sickels. Watt was strongly opposed to the use of high steam pressures, and approved of nothing above 10 pounds at the safety valve; about 7 pounds was his idea of the correct thing, and for his pressures Watt's steam engine has never been excelled; he reached a coal consumption of less than 2 pounds, as little as could be obtained to-day with his steam pressures; and for durability, cheapness, safety and low repair cost, the engines of James Watt have never been excelled. Watt was well aware of the fuel economy to be gained by the use of high steam pressure, but to his mind the difficulties and dangers attending the use of such pressures as are now daily practiced were such as to render any steam pressure above 10 pounds unadvisable, and the success he obtained with his tight single valves, vertical cylinders, and small friction, gave him every reason to believe his views correct. But with even so low a pressure as 35 pounds there is a great gain by the employment of a more rapidly closing steam admission valve than is possible with any valve gear which Watt devised, or with any valve gear made up to the time that Frederick Sickels, apprentice at the Allaire shops, saw this slow closing valve defect in Watt's engine, and, at the age of nineteen or twenty years, devised his brilliantly simple method of obtaining the quickest closing valve possible; an invention worthy to rank with James Watt's simple ideas of separating the condenser from the cylinder, and using steam on both sides of the piston, which were the foundation, and, except details, the sum of his inventions.



A SICKELS STEERING GEAR WITH A HISTORY.

With the heavy parts of such engines as Sickels, the Allaire apprentice, was familiar in his daily life in the Allaire shops, no rapid action was possible; therefore with that simple directness which marks inventive effort of the highest order, with that boldness and certainty of the correctness of his convictions which leads genius to its successes and the religious zealot to the stake, Sickels cut the steam admission valve away from all its massive actuating parts, so that he could have a small, light piece only to move. No bolder thought in steam engineering exists than this conception of the apprentice boy of the Allaire Works. Of all the parts of the steam engine the steam admission valve must be most surely placed and handled; its time of movement must be precisely fixed with relation to piston position. To let go of this valve at one point so that the valve might be as light and hence as quickly moved as possible, and to pick it up again so as to move it with absolute certainty as to time and space, and to do this new thing with noiseless and durable mechanical elements. Such was the formidable task to which the boy Sickels betook himself; he succeeded amid the sneers and jeers of the recognized masters of his craft, and he reached his reward—a life of unremitting toil, unending disappointments, poverty, actual want, the receiving of charity, and a recognition at last as one of those whose names are to live after death. It is true that Sickels saw the whole steam-using world adopt his invention of the "trip" cut-off valve, the detached, rapidly closing steam admission valve, but it was as the "Corliss," not as the "Sickels" engine.

Frederick Sickels' favorite younger sister, Eleanor, asserts that George H. Corliss and Frederick Sickels were apprentices together in the Allaire shops. Richard Ryan, who learned his trade at Hinckley & Drury's shops, South Boston, before Jackson was President, and was at the Allaire shops in 1844, is certain that Corliss worked at the Allaire shops. Miss Sickels says that not only were Corliss and Sickels apprentices together, but that Sickels talked over all of his ideas and inventions with his friend, who was either then or soon after a draftsman. Another account, which is circumstantial, says that Sickels met Corliss first in Providence, and there disclosed to him all of his ideas in regard to the "trip" cut-off, or detached steam admission valve. Certain it is that Corliss, almost contemporaneously with Sickels, began his life-work on detaching valve gear; certain it is, also, that although Sickels gained some barren victories over Corliss in the courts, which were unsup-

ported by such subsequent proceedings as might have made Sickels rich and famous, Corliss retained to the last the credit of the invention of the trip cut-off, and died possessed of millions of money, and a world-wide reputation as the improver of the steam engine. He was the one of the two men who had the commercial instinct; his was the wit to see and grasp the opportunity of the present; to arm himself with the might and shield of wealth, and to hold his claims as an inventor against Sickels who was poor, and was regarded by all save a few as a visionary, impractical inventor, as indeed he was; visionary to the extent of seeing clearly with his boyish eyes the broad future of the work of his 'prentice hands, and impractical, as he did not make his clear, true vision see the way to wealth for himself as well as to money savings of incalculable magnitude to the steam-using world.

Corliss took the oscillating valve and added a detail which made it free, and he made the time of the valve "trip," or release, deter minable by the action of the governor. These were highly creditable minor ideas, and they were the culminating combination, which, although but the usual selection from the failures of the past, proved of vast commercial value; this value was due to those vivifying touches of genius with which Corliss revived the dead efforts of his predecessors, and combined them with the work of Sickels. Had it been possible for these two talented, but differently talented, men to co-operate, it is likely that both of them would have gained great wealth, and each have been universally credited with having contributed very much to the advance of the practice of steam engineering. No shadow would then have been cast over the fame of either of them as an engineer and inventor.

Specifically and in detail, what Sickels did in the "trip" cut-off valve gear is shown in Figs. 1, 2 and 3, from the Allaire drawings of beam engine No. 92, 52 inches diameter of cylinder by 132 inches stroke.

A valve released from the parts which move it is required to reach its seat and close the admission of steam to the cylinder as soon as possible, but it must not strike its seat (in case of a puppet valve as used by Sickels) with a destructive blow. To avoid the blow consequent upon the sudden stop of a heavy, quick-moving valve meeting its seat, Sickels introduced what he called a "dash pot," the advent of which was greeted with a couplet of derisive doggerel still remembered among the older engineers as used in ridicule by the leaders of the profession at that time. The "dash pot" consisted of a plunger sliding in a closed cylinder filled with fluid, air or oil being the fluids used. Sickels made his first experiments with two glass drinking tumblers, tapering in the usual form, held in his hands, dropping one glass into the other partly filled with water.

The section of the dash pot, Fig. 2, shows the construction clearly; as the plunger drops, the fluid is forced up through the openings *A* in the plunger into the hollow body of the plunger, the small portion of the fluid confined in the small supplementary cylinder finally affording a solid stop to the descent of the supplementary piston *P*, forming the lower end of the hollow main plunger. The "die," as the piece which lifts the valve is called, surrounds the valve stem, and is fitted to just drop through the "die lifter," when the lifter is turned to a certain position; in any other position the die cannot pass through the die lifter; hence, if the die lifter is brought below the die in position so that the teeth of the die do not coincide with the spaces in the die lifter, then the rise of the die lifter will carry the die up with the lifter; but if the die lifter is turned at any time so that the teeth in the die coincide with the spaces in the die lifter, then the die carrying the valve rod and dash-pot plunger will be free to fall until brought to a stop by the dash pot with the valve on the valve seat. The exact time of the seating of the valve is governed wholly by the curve of *P* at its lower corner *C*. This arrangement of the puppet valve is not so good as the Corliss valve in point of stop, but the single puppet valve is perhaps the only surely steam-tight valve yet produced.

Fig. 1 is a side elevation of the Sickels cut-off valve gear. The dotted die lifter rotating bell crank is pivoted to the eccentric-driven, lifting rod, which has an unvarying reciprocation, and brings the die lifter under the plane of the bottom die when the eccentric-driven lifting rod is in its low position; the die lifter is then partly revolved by a spring, acting on the end of a rack geared with a segment of teeth cut on the edge of the die lifter, so that the spaces in the die lifter do not match the teeth of the die surrounding the valve rod, and hence, as the lifting rod rises carrying the die lifter up, the die lifter also raises the die, and the valve and dash-pot plunger which are connected to the die. The releasing bell crank, carried by the lifting rod, has a cam-shaped end to its horizontal member. The bell-crank cam end acts on a roller secured to the die-lifter rack to turn the die lifter at a time determined by the hand adjusted length of the adjustable die actuating rod at the right. The drop bell crank turns on a fixed center at *D*, and the releasing bell crank time of action to turn the die lifter and drop the valve is had through the radius rod, Fig. 1. The drawings show the valve gear for a heavy engine, and represent the most approved Allaire shops' practice. Corliss retained the dash pot and the "die," though he used commonly but a single tooth in place of the 8 teeth shown in these drawings, the 8 teeth having a very much greater work endurance than the single tooth. Without Sickels' dash pot and Sickels' "trip" or valve release, the "Corliss" valve gear would be impossible in practice.

Barber has been printed as antedating Sickels in the use of the "trip" and the "dash pot." There is no foundation for such credit to Barber. Barber's name does not appear in any of Sickels' lawsuits in such connection, which alone is ample proof that Barber had no such standing. Mr. Thos. Rowland says he does not know that Barber used the dash pot and trip, but has an impression that he did use these features. Barber was before Mr. Rowland's day.

Mr. John Burns, who erected 52 engines in his time and was "outside man" 37 years with the Allaire shops, says that Barber was a drunken fellow, a good mechanic who was not working at all, and came around Burns very often when Burns was putting the machinery into the steamer "Swiftsure," in 1834; the "Swiftsure's" engine was built by Brown & Dunham, at the shops in North Moore street, near West street, New York. Barber claimed to be the real inventor of the long toe cut-off, patented by Stevens, and his claim was believed among the shop men. It was his constant boast that all he had to do was to go to the office of Stevens and get a five-dollar note whenever he wanted it. Barber was always half drunk and a great talker, and told Burns of many great things he had in view, but never mentioned a "trip" or dash pot in the lot. He appears to have had the full credit of the Stevens valve gear invention, among the shop men of the day, and drank himself safely to death, out of Stevens' way, within a few years from the date, 1834, at which Mr. John Burns remembers him on the "Swiftsure." Mr. Burns first knew Sickels in 1842 or 1843, when putting the engine in the "Hunchback," a Staten Island boat, fitted with the Sickels cut-off. It is to be regretted that the space available for this paper forbids the fuller use of Mr. Burns' recollections, as well as all notice of the Sickels-Dickerson Detroit pumping engine, the suits of Sickels in various infringement cases, and a vast amount of historical matter gathered in this connection.

Mr. Frederick E. Sickels took out eight patents on steam-valve subjects, including extensions and re-issues, eight patents and extensions and re-issues on steam steering gear, and sundry patents on steam engine construction, including one on a compound beam engine. His other patents were on pneumatic bridge piles, paddle wheels, and one on a dumping scow. The whole list includes only about thirty issues, confined to very few subjects, so that Sickels cannot be called a prolific inventor. Really, his whole life nearly was devoted to the cut-off, and another equally simple, brilliant and unavoidable invention in steam-valve handling which makes steam power available for the extremely delicate operation of handling a ship's rudder.

This invention of Sickels is now in use upon almost every steamship of any magnitude afloat, and many tugs and other small craft are fitted with it, and in this case as with the trip cut-off, Sickels' ideas were not only correct, but embody the only method by which the object sought can be obtained. The rudder of a ship must follow the wheel, start as the wheel starts under the impulse of the steersman's hands, stop when the wheel stops, and remain immovably fixed until the steering wheel is again moved. This end was gained by Sickels, as shown in Figs. 5 and 6. A single eccentric will operate correctly the valves of two steam cylinders set at 90 degrees from each other, and two steam cylinders so set will turn a shaft. Sickels therefore connected the eccentric to operate the valves of a pair of 90-degree cylinders, not to the engine shaft, but to the shaft of the steering wheel; hence, if the power of the engines is enough to move the rudder, the engines make exactly turn for turn with the steering wheel. The only important improvement since the first steam steering gear was made by Sickels, was made by Mr. Mooney, now chief draftsman at the Morgan Iron Works, who put a rope-driven multiplying gear between the steering wheel shaft and the eccentric carrying shaft, and thus made, say, ¾ of a steering wheel turn give the eccentric shaft the, say, four turns needed to put the helm hard over, and at the same time limited the number of eccentric turns possible in either direction, and thus stopped the engines whenever the rudder reached either extreme position.

There are no means at hand for finding the exact returns which Sickels had from the use of the cut-off. There is reason to believe that they were extremely small.

Mr. Chas. H. Haswell thinks the first Sickels cut-off was put on the "North America," a North River boat, engined by Hogg and Delamater, and put in service in 1838 or 1839. Mr. Haswell first knew Sickels at Washington in 1843. Sickels endeavored to have his cut-off adopted by the U. S. Navy, and finally, under Mr. Haswell, then engineer-in-chief, the cut-off, greatly opposed by all the prominent engineers of the day, was put on the U. S. ship "Water Witch" in 1847, and on two larger vessels in 1848, one being the "Powhatan," at that time regarded as the best war ship afloat. In all cases the Sickels cut-off proved a great success as a fuel saver. What Mr. Sickels received from the government is not known.

The Allaire Works' drawings were purchased by the Morgan Iron Works, owned by John Roach, and Sickels was very well-known at those shops, where Mr. Mooney, then a very young man, became his favorite draftsman, carried out all of Mr. Sickels' later ideas, and made the first drawings of the steam-steering gear. The first steam-steering gear was built without drawings, and put on a boat purchased for the purpose, thought to have been a ferryboat on the North River; this invention was perfectly successful from the start; the trial trip was

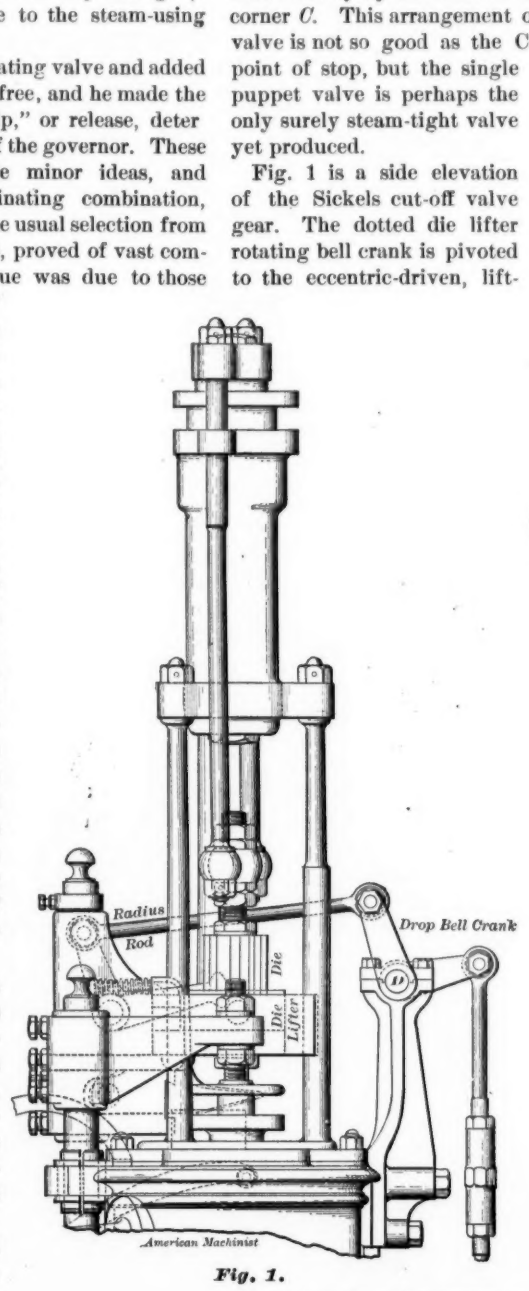


Fig. 1.

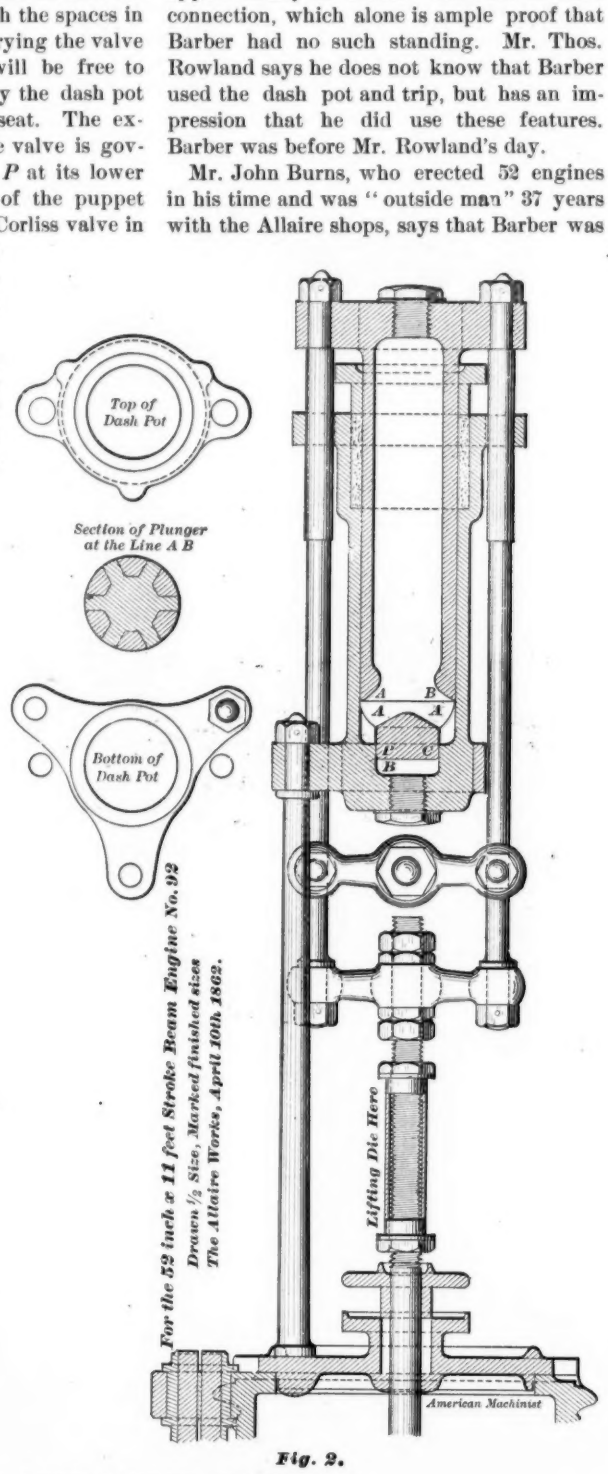

Top of Dash Pot
Section of Plunger at the Line A B
Bottom of Dash Pot
A
B
C
Lifting Die Here
For the 52 inch x 11 feet Stroke Beam Engine No. 92
Drawn ½ Size, Marked finished sizes
The Allaire Works, April 10th 1862.
American Machinist

Fig. 2.

From an Old Drawing of Sickels' Cut-off and Dash-pot.

made with Mr. Edward N. Dickerson at the wheel and Mr. Sickels himself at the throttle valve, and Mrs. Sickels as the sole passenger. The wildly tortuous course of the boat, made to fully test the prompt action of steam-steering gear, was so erratic as to cause Mrs. Sickels to express a profound feeling of relief when she found herself safe ashore after the alarming voyage.

Sickels was certain from the results of this trip that the steam-steering gear must come into immediately universal use. He formed a partnership with Mr. William Judson, of New York, and early in the sixties, after doing some work on the U. S. war ship "Pensacola," during which he gained the intimate friendship of President Lincoln, Sickels, full of hope and courage, went to England with the steam-steering gear.

The result of his four-years' stay in England is best told in his own words in the only manuscript of his so far found. The first page of his expense account is missing, but the items remaining and total footing are quite sufficient to give a correct idea of the outcome. That portion of the manuscript found reads as follows:

"In commencing the attempt to introduce steam power I was ignorant of the difficulties which laid in the way. I can illustrate my experience by referring to the case of the breech-loader, which was kept out of use for a quarter of a century by the universal doubt in the minds of military men as to its practicability, and the introduction of steam power applied to rudders will come into use only as the unfavorable impression is removed by practical demonstration and investigation. To make this demonstration and induce its investigation has occupied many years of my life. In my early attempts I endeavored to secure its introduction by confining my efforts to this, my own country, but as it was supposed in 1862 that the World's Fair, in London, would be the only opportunity to get the nautical world for an audience, I concluded to place the machine I had already built and put in practical operation in that exhibition, believing that the chance of getting it introduced into the United States would be enhanced by a favorable notice of it by foreign nautical men.

"Before starting for Europe I made an arrangement with my brother, Theo. E. Sickels, of New York, to take charge of the patent during my absence, and he was to watch any opportunity to introduce the invention. Accordingly he built a machine and placed it on the steamer 'New World.' This machine was subsequently put on the U. S. steamer 'Roanoke.' In all cases where I have personally or otherwise attended to this invention I have found it necessary to volunteer—giving my own time, labor and expense of whatever name or nature—as it has been regarded as impracticable by nautical men.

"I lost even my clothing, books and papers at the great Chicago fire, so I am unable to give the details of my operations in my efforts to introduce steam steering as fully as I might otherwise have done. I have brought the knowledge of the invention to the prominent nautical men of all nations, but during nearly all this time it has been condemned by them. I found when it was exhibited in the Crystal Palace, New York, that I had to buy tickets of admission, and give them away to induce parties to come and look at the machine. When it was in London it was regarded as visionary.

"As the Americans had no place in the machine department assigned to them in the Exhibition of 1862, I placed the steam-steering machine in the Belgian department, at the same time keeping an American flag (which I still have) flying over it to indicate the nationality of the invention.

"In 1862 the overwhelming prejudice against Americans, from causes arising from our internal affairs, made it impracticable for an American to submit to the insults and sneers offered to him in England when he proposed to show a new invention to Englishmen, as they persisted in confining their conversation to and exulting over the then, as they claimed, critical conditions of the United States.

"However, by its continued exhibition, from the opening to the close of the fair, with an Englishman employed by me to be in constant attendance to show and explain it in operation by steam to the vast concourse of visitors, sufficient impression was made upon the general sentiment of nautical men to enable an Englishman, some four years afterwards, to place a steam-steering machine on the 'Great Eastern.'

"I may here mention that in 1860 I offered to build a steam-steering machine for the 'Great Eastern,' to be paid for if it was entirely satisfactory. To this I received no reply. The captain of the 'Great Eastern' at this time declined my urgent invitation to examine the machine then in operation on the steamer 'Augusta,' although I offered to take the boat out under steam at my own expense, at any time to suit his convenience, while the 'Great Eastern' and the 'Augusta' were lying in New York Harbor at the same time. Subsequently, in 1862, when I was in London, the engineer of the company owning the 'Great Eastern' declined to grant me an interview upon the subject of steam steering, sending me word that it was useless. Just previously, pains had been taken by my brother in New York to show the then captain of the 'Great Eastern' the machine built for the 'New World,' when in the shop and in operation, and he had expressed himself as favorably impressed with the value and utility of the invention. I have offered to various parties to place the steering machine upon their vessels at my own expense, but have never received the least encouragement.

"I superintended the construction of a steam-steering machine for the U. S. steamer 'Pensacola,' at the Washington Navy Yard.

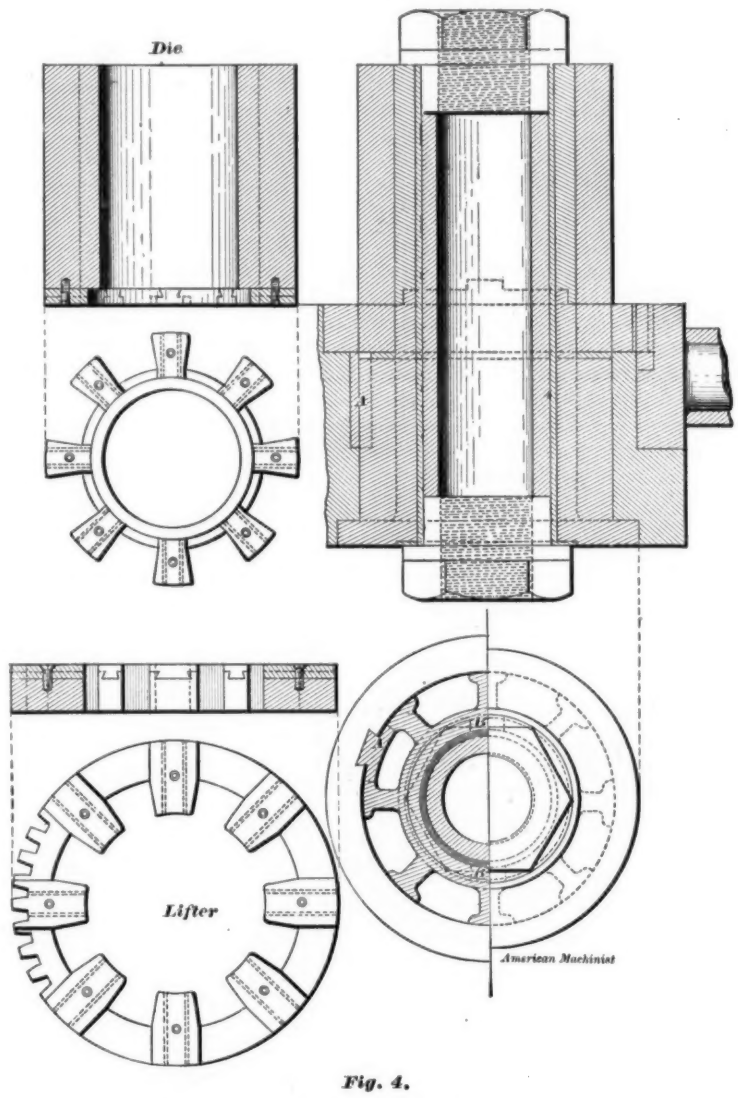


Fig. 4.

Before its completion the prejudice against it was so great as to influence the Secretary of the Navy to decline to properly finish it. It worked successfully, notwithstanding it was improperly placed upon the boat, as the Secretary of the Navy refused to order a steering wheel to be built for it. It was the operation of this machine that satisfied the then examiner of the patent office, Mr. King, that I was entirely correct in my first theory of the operation of steam steering, as explained in my application of 1849, thus causing him to grant the patent of 1860, which claims moving and holding the rudder by the action of the steering engine alone.

"I should mention the steering machine which I first exhibited in 1853 at the Crystal Palace in New York was added to in the second year of the exhibition, so as to be also a hoisting engine, in consequence of the poor encouragement the machine received. This was done to induce steamboat men to use it, if it could be used, both to steer and unload the vessel. And at great expense I had it fixed with a hoisting apparatus placed behind the steering wheel, and employed a man to show how readily it could be changed from a steering apparatus to a hoisting machine, and this machine continued on exhibition from its opening to the time of the destruction of the building. In making these alterations, I incurred part of the expense charged in account of Exhibition in Crystal Palace.

"I should also mention that I contributed to the printing of the United States Official Catalog, and gratuitously circulated many thousands of them during the International Exhibition in London in 1862. (A copy of which accompanies this statement. It contains an account of my steering machine on exhibition, with a favorable notice of the U. S. Commissioner, and the statement that I was awarded a medal for its ingenuity. See page 51; also page 4 of the appendix.)

"The invention is also shown in the official illustrated catalog published by Her Majesty's Government as the 'first pioneer steering machine.' Copies of this catalog are sent to all the principal libraries of the world. It was also favorably noticed in work edited by D. K. Clark, the engineer in charge of the machinery department of the exhibition.

"The two most recent circumstances that demonstrate the difficulty of introducing steam steering as they occur to me are as follows: As soon as I found that an American line of transatlantic steamers was to be started from Philadelphia to Europe, I called on the engineer with my drawings and papers. He told me that it would not be desirable to look at them as he intended to follow English plans only. The other circumstance is this:

"The chief engineer of the line, P. M. S. Co., stated to the manager of the line that he was familiar with my invention, approved of it, and could get the work done in this country. The reply was: 'No, we will *import* our steam-steering gear.' I will here observe that all our plans for ocean steamers are now servile copies of the English, and the impression is general that we have in all things first to learn to copy the English engines, thus demonstrating that if I had not laid the foundation of steam steering in England it would not be in use at all to-day.

"This last circumstance occurred in October, 1873, nearly a quarter of a century since my first application.

"Several patents have been taken out in foreign countries with this invention, but I never received any compensation whatever from them nor for my American patent.

"In 1853, by advice of some friends, I was induced, as a means of partial protection, to take out a patent for a modification of my original invention, embodying in the combination a fourth element, viz., the combination of the steering engine, the propelling engine, the rudder, and the steersman handle. Whereas my original invention consists in the combination of but three instrumentalities, viz., the steering engine, the rudder, and the steersman handle. Whatever of value or importance there may have been in the combination as claimed and patented in 1853, has gone to the public, as no application for an extension of that modification of my original invention was made. In making an application for the particular combination claimed in the 1853 patent, I did not abandon, or withdraw, or modify my original invention and application therefor made in 1849. The introduction of the fourth instrumentality in the claim, viz., the 'propelling engine,' I never had much faith in, as the steering apparatus must and ought to work independent of the propelling engine, that being the leading characteristic of my original invention, which I persistently clung to, until it was allowed and patented to me in 1860.

"This invention applied to a steamer will save on an average the work of from 10 to 20 men, or from $25 to $50 per day. This is for wages alone, but the greater value of the invention is in saving of human life, vessel and cargoes in storms at sea, and when hand steering is almost impractica-

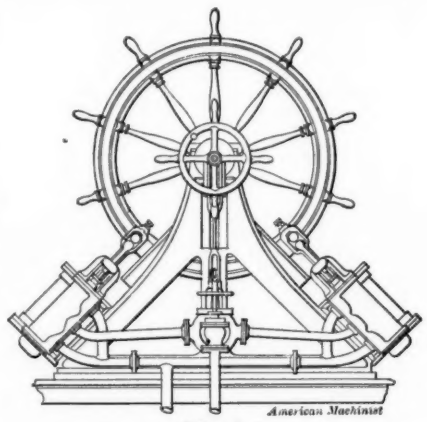


Fig. 5.

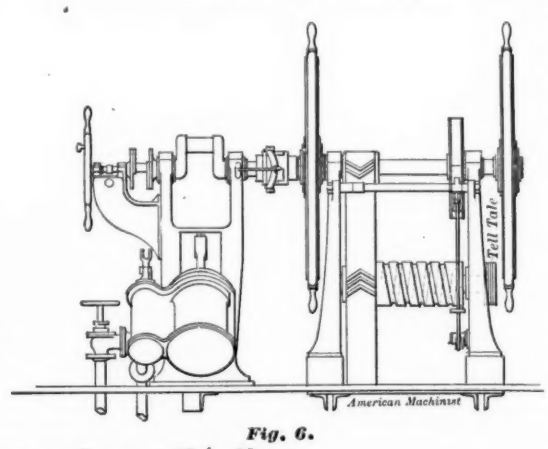


Fig. 6.

THE SICKELS STEERING GEAR AS NOW MADE.

ble. Moreover, steering by steam power admits of building steamers of very much larger capacity than without its use."

Amount forward.....	$4,250
World's Fair in London, including hire of attendants to explain the machine to visitors; also including steam pipe and putting up the machine so as to exhibit it in constant operation under steam.....	1,700
1863 to 1866:	
Cost of the construction of models for exhibition, to show the effects of *power* applied to the rudder instead of *hand* power.....	2,500
1867:	
Cost of exhibiting these models in New York..... Note: These models were deposited in the Navy Yard in Brooklyn and exhibited in operation by W. W. Woods, Chief Engineer U. S. Navy, to Commodore Farragut, and to prominent officers of our Navy, and also to foreign officers visiting the Navy Yard. Two of the small models have been stolen, but the principal model is now deposited in the Lyceum attached to the yard. I exhibit these models in operation to Gen. McClellan and others as I find opportunity.	100
Expense 4 years in Europe urging the adoption of steam steering... This does not include indirect loss arising from persistently advocating steam steering to men in my own business who thereafter always regarded me as visionary, and avoided all business relations with me.	12,000
Cost of time spent in visiting men and places to keep the subject of steam steering before the public; also including the time I have spent in superintending the making of machines and models and publications, and also including my traveling expenses, 20 years at $500.....	10,000
Total expenditure.....	$30,550

In a pamphlet, unsigned, perhaps written by Dickerson, printed by Southwick, at Harlem, N. Y., 1868, it is stated that the steam-steering gear was a great success on the steamship "Great Eastern," and *Engineering* (London), November 29, 1867, says "The Lords of the Admiralty have ordered Messrs. G. Foster & Co., Liverpool, to fit the 'Northumberland' with steam-steering gear."

Mr. Geo. E. Weed gives the following as the sums paid Mr. Sickels by the Morgan Iron Works:

For use of steam-steering gear from 1876 to 1890.....	$10,876
Royalty on "cut-off" on "Bristol" and "Providence".....	2,000
Total.....	$12,876

A meager reward for a life-time, and yet it is thought that the Morgan Works paid Mr. Sickels much more than he received from all other sources for the use of his inventions.

This paper already far exceeds the limits proposed, and the personality of Frederick E. Sickels cannot here be touched upon, further than to say that he was invariably courageous, hopeful and cheerful in the midst of disappointments. He viewed the faults of men as due to errors of their moral machinery, and did not hold personal ill-feeling even towards those whom he might have been held justified in thoroughly hating. Thus he could say to his niece, Miss Stevens, on returning from his last interview with Corliss, shortly before the death of Mr. Corliss, "Poor, old man! With all his wealth he is not so happy as I am to-day."

Despite disappointments and laurels borne by others, which should rightly have rested on his own brow, his was not, perhaps, an unhappy life. The mechanical world had, by universal adoption, put the seal of approval on his work long before his death, which has been previously, briefly noticed in these columns, and he doubtless felt what the words expressed when he said to his favorite sister, Eleanor, at their last meeting in October of last year, "The Lord has been very good to me."

Fortune smiled more kindly on the lives of the brothers of Frederick Sickels, who lived to man's estate. William B., born October 28, 1817, engineer and chemist, writer on scientific subjects, is now living in Yonkers, N. Y., in the well earned repose of declining years. Theophilus Elsworth, born December 28, 1821, led the Cochituate water into Boston in his 26th year, while chief engineer of the Boston Water Works. He was also chief engineer of the Union Pacific Railway, built the Omaha Bridge over the Missouri, and was chief engineer of the Hannibal & St. Joseph Railway. He died in 1887, honored and wealthy.

Jackson Elsworth, born October 17, 1828, was chief engineer of the Atchison and Pike's Peak Railway, and is now connected with railway interests in Virginia.

David Banks Sickels, born February 8, 1837, was also a civil engineer by profession. United States Minister to Siam under President Hayes, is now vice-president of the American Surety Co., 160 Broadway, New York.

After Frederick Sickels' ill fortune with

the steam-steering gear in England, he seems to have abandoned his active efforts to promote his own inventions. He took service with his brother Theophilus, on the Union Pacific, and assisted in the construction of the great bridge across the Missouri at Omaha. He then accepted the position of chief engineer and general manager of the Kansas City Water Works, which position he held at the time of his sudden death from heart failure, at the Water Works, on the 9th of March, 1895, in his 76th year.

It will be seen that all the sons of Dr. John Sickels were men of far more than ordinary attainments, but it will be the name of Frederick, inventor, and least successful of all in the world's view, which will carry the name of the family to all future generations, so long as coal is burned under steam boilers, as one of the few great improvers of the steam engine.

A LETTER FROM CHARLES T. PORTER REGARDING SICKELS.

Editor American Machinist:

I cheerfully respond to your request to contribute what I can to the memory of Frederick E. Sickels. This, however, is very little. There are many who are well acquainted with his engineering history, and no doubt it will have justice done to it.

I first met Mr. Sickels in London, at the International Exhibition of 1862. He was there for the purpose of exhibiting and introducing his steam-steering apparatus, now in universal use on ocean steamers, by means of which, while the man at the wheel goes through the same motions that he was always accustomed to, the steam does the work of moving the rudder and holding it in position. He brought to the Exhibition one of these machines that had seen hard service. It had been on a coasting steamer, which had been seized by the Confederate Government, and used as a blockade runner. This vessel had been captured by our blockading fleet, and had been sent North, and condemned and sold. Mr. Sickels had bought the steam-steering gear and taken it out of the vessel, and sent it to the London Exhibition. It presented, I remember, a sorry appearance, which a coat of paint and a little polishing would have remedied. But Mr. Sickels would not have it touched, took pride in having it seen just as it was, after having, as he said, been "managed for a year by niggers." It was connected with the steam, and was shown every day working just as perfectly as if it had been gilded on the outside. Engineers all saw it, everybody worked it who pleased, but for some reason no one seemed to take any interest in it. I never saw anything treated with more general indifference, and I made up my mind that it was all on account of its shabby appearance. Whether Mr. Sickels ever reaped any reward for this important contribution to the engineering wealth of the world, I am quite ignorant.

At the Philadelphia Centennial Mr. Sickels made an interesting exhibit of his inventions, for which his original models had been loaned to him by the Patent Office. This exhibit was entirely of a historical nature, his patents having all expired. The board of judges on steam machinery, of which I had the honor of being a member, were all enthusiastic over this exhibit; our foreign members, to whom it was new, were especially so. We made an award to Mr. Sickels, which was signed by every member of the board, including Horatio Allen. I was especially gratified by Mr. Allen's cordial concurrence in this award to Mr. Sickels, in view of the fact that in the old days, when Mr. Allen was president of the Novelty Iron Works, in New York, a strong antagonism had existed between them. I well remember when Mr. Allen read the award, he remarked that it was fully deserved, and he should sign it with pleasure.

This award never saw the light. It was thrown out by the committee of revision, of which committee Geo. H. Corliss was chairman. I procured a copy of the award, which I gave to Mr. Sickels, and I presume it has been preserved by him. The original may be on file among the records of the 1876 Exhibition. On this point possibly General Walker may throw some light. I should be glad if this award could be found and published, in order that the world might see the exact language which the committee of revision felt it their painful duty to reject.

I never learned that this committee found it necessary to exercise their censorship in any other case whatever, and am under the impression that it did not. If this be so, the suspicion becomes very strong, that all this machinery of a committee of revision was got up for the mere purpose of enabling Mr. Corliss to sit in judgment on his own case, and throw out the award that must inevitably be made to Mr. Sickels for the invention of "the trip cut-off."

Charles T. Porter.

A correspondent states that at the works of Mackintosh, Hemphill & Co., Pittsburg, Pa., an electric traveling crane weighing 72,000 pounds, with 49 feet span and with a lift, to the line of the rails, of 29 feet, was erected under the direction of the assistant superintendent, Mr. McFadden, in five hours from the time of beginning work until the crane was ready for operation. This included the placing of all the parts, making the electrical connections, etc.

Casting a Gun by the Rodman Process.

By G. A. Webster.

In your edition of May 25th, I notice an article on "Guns," which treats on the advancement made in their construction.

Having had some experience in the more modern methods of making cast-iron guns, I will endeavor to give the American Machinist readers a description of casting one by the Rodman process. By this process the gun is cast breech down, and a stream of water is forced through the bore, cooling the center, while a hot fire is constantly burning at the base keeping the outside of the gun hot, thus causing a gradual cooling from the inside towards the outer surface.

The first step of importance in making these guns (after securing the order) is to make the tools by which the work may be done as cheaply and thoroughly as possible. Two pits are necessary, one about 8x16x6, used for convenience in molding, and the other, the regular pit found in every foundry, made of brick and boiler iron, 12 feet in diameter, and as deep as the length of the gun to be cast. This pit is fitted with a circular grate at the bottom and at the top with two flues, or chimneys, used as smoke and draught flues for the fire which is to be lighted at the base of the gun. It is used for casting and cooling, and is water and air tight.

The flask or box in which the mold is to be made must be constructed next. This is composed of a number of cast-iron tubular sections, about 5 feet in diameter, 4 feet long and ¾ of an inch in thickness, flanged on both ends. These sections are cast full of ½-inch holes, 2 inches apart, known as vent holes, through which the gases formed by casting are allowed to escape.

The bottom plate, or plate upon which the whole casting and mold is to rest, also comprises part of the flask, it is made of cast-iron about 4½ inches in thickness, and as large in diameter as the diameter of the flanged sections. The flask when ready for use may be compared to a number of pieces of 48-inch heavy flanged pipe, bolted together and stood upright on a heavy plate, Fig. 1, page 265. Having thus provided a flask for the outside of the mold, we must now provide for the inside. To form the hole or bore in the casting it is necessary to devise some method of support for the sand. This is done by means of a long cast-iron tube called a core arbor, Fig. 2. The cast-iron tube, or core arbor, is made long enough to project about three feet above the flask and extend to the bottom. It has a 2¼-inch hole in the center, extending the full length. The outside is corrugated, having slots planed lengthwise, the full length, to allow the gas, formed when casting the gun, to escape. Through the hole in the center of the arbor is a water pipe extending to the bottom, through which the water passes during the cooling process. In using the arbor to make the core it is necessary to have it rest in such a manner as to be easily revolved, and also to be placed in the oven without disturbing it. To do this a carriage (the arbor cradle) is constructed which is simply a long truck with a bracket at either end to support the axes of the arbor, Fig. 3.

Having the flask and core arbor, the next in order are the ovens and furnace. The ovens used for baking or drying the molds are ordinary brick ovens with extra large fireplaces. The furnace for melting the iron is called an air furnace, and is a large square box about 25 feet long, 10 or 12 feet wide, and about 8 feet in hight. The walls, being made of fire brick and clay, are 18 inches thick and are supported by ½-inch iron plates and heavy iron binders. The chimney, or stack, is about 7 feet in diameter and 100 feet in hight. At one end of the furnace, for about six feet, is the fire box, in which soft coal is burned. The space next to this, for about eight feet, is used to melt the iron, which is piled "criss-cross." At about the center of this chamber and level with the hearth of bottom, is the hole through which the iron is allowed to flow when hot, called the "tapping hole," see Fig. 4.

Having the tools complete, the work of molding the gun may be commenced. First, the bottom plate is lowered into the pit and one section of the flask is placed and bolted to it. The pattern, or form, by which the mold is made, is then placed in it and the work of ramming the sand around this is begun and continued, one section after another, until the whole flask is rammed. The pattern is then drawn out and the mold is ready to be baked. In doing this the flask is separated into its different sections and all are placed in the ovens, where they are allowed to remain until perfectly dry, requiring from three to three and a half days. While the mold is in the oven the men are kept busy in making up the core, or that part of the mold which forms the hole in the gun. This is done by first winding the core arbor with a small rope, called sisal, and then covering it with very wet sand, care being taken to keep the arbor always revolving while the sand is being put on, thereby securing a circular core. By winding the arbor with sisal a number of small spaces are left open from the top to the bottom of the core, and it is by these openings that the gases escape.

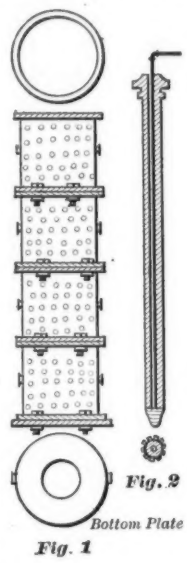


Fig. 1

Fig. 2

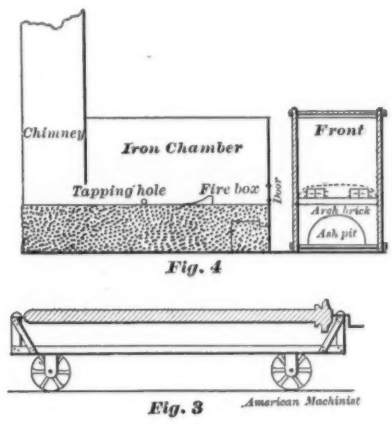


Fig. 4

Fig. 3

Casting Guns.

The core, being already on its cradle, is rolled into the long oven where it is baked until perfectly dry and hard.

About the time the core is placed in the oven the mold is ready to be taken out and given a coat of blacking (black lead and water) which is put on before it cools, thus the heat dries it and leaves a smooth, hard, slippery surface.

The sections are now lowered into the large pit with the aid of powerful cranes, the bottom section first, and so on in the same rotation as they were taken apart when first taken from the small pit. The flask is now securely clamped and bolted together, and the mold is ready to receive the core, which is taken from its oven, and also given a coat of blacking. It is then lowered lengthwise into the mold, the lower end being guided into the center by the aid of a circular hole in the bottom, while the upper end is held central by a cast-iron sleeve supported by the outside of the flask. After the core is securely set the water pipe running down the center of the arbor is connected with the tank, and the fire at the bottom of the pit is gotten ready to be lighted. The pit is then tightly covered with sheet-iron, and everything is all ready for the iron which has been melting for about ten hours.

The iron being found by frequent tests to be in proper condition, the clay obstruction in the tapping hole is removed, and a stream of hot iron about two inches in diameter is allowed to flow into the mold, passing directly to the base and filling it by small openings, or runners, made for the purpose. The process of filling the mold generally occupies about 10 or 12 minutes. When it is filled to within an inch or two from the top, word is given to the man at the tapping hole who stops the flow of iron, and the gun has been cast. It is left in this position with a fire at its base, and a stream of water running through its center until cool, which occupies three or four days. It is then taken out, cleaned and sent to the machine shop to be turned and bored.

An Experiment with Water.

Take a pound of water, the temperature of which is 80 degrees centigrade, and mix it with a pound of water at 0 degree, or freezing point; the mixture will make two pounds of water, the temperature of which is 40 degrees centigrade.

Now take another pound of water at 80 degrees centigrade, and mix with it a pound of crushed ice—that is, ice crystals at 0 degree centigrade, the same temperature as the cold water in the first mixture, and the result is that we have two pounds of water at freezing point.

In both cases the weight of matter at 0 degree centigrade introduced into the warm water was the same, but before the ice crystals could assume a liquid condition they had to absorb a certain amount of heat. That heat was drawn from the warm water, and consequently reduced its temperature, but it did not raise the temperature of the ice; it simply acted as energy in enabling the ice to become liquid, and remained in that liquid in the form of latent heat, to be given up again as soon as the water reassumed a crystalline form.—*London Knowledge.*

Small Taps.

By Warren E. Willis.

While it is unquestionably cheaper to purchase the commercial article of small taps for ordinary purposes, sometimes such conditions prevail that it seems desirable to make them.

The case in hand called for the use of a large quantity of brass screws, in work subject to such an unusual amount of vibration that a good fit was absolutely necessary, and as everyone, who has had much to do with factory-made machine screws, knows of the variation in sizes even in the same box, the expedient was devised of sizing them down to a definite standard. Perhaps 10 per cent. would come too small, but even then it was cheaper than to make them outright.

Having arrived at a standard screw it was found that out of a dozen taps, as bought in the market, but two or three of the lot would make a hole in which the screws would properly fit. After trying several different makes in vain, we found it necessary to do one of two things: have them made to order to match our standard, at an almost prohibitory price, or to make them ourselves. Both plans were tried, but the results we finally attained ourselves, proved the more satisfactory; our experiments led us to devise a method for making, in small quantities, a range of sizes from .062 inch to .250 inch in diameter, and of pitches to correspond as per list.

As a limit of .00025 inch only was allowed, the greatest care was exercised, it being found necessary to determine the average change, in each lot of steel, in tempering—often more than the limit of tolerance—before cutting, so as to make due allowance for it.

Crescent, Stubbs and Kidd drill rod have each been used, and it is yet a question whether there is any real choice in these high grades of tool steel. As in other things, an occasional inferior rod is received, but it is as likely to occur in the most expensive imported article, as it is in the domestic; moreover, the writer does not believe that an expert even can determine which is one or the other from a group of mixed samples of like shape, from the appearance it may have, or from any tests he can make.

To return—the rod, of a size as near as possible to the diameter of the shank, is cut to the proper length and accurately centered; on the smaller sizes, male centers being used as the ordinary ones would weaken the tap at its thread end too much, turned for the thread as usual and rough cut in a lathe sufficient to give it a good lead, say, from 60 to 80 per cent. of the stock is removed in the roughing.

The illustration, Fig. 1, shows the fixture in which they are finished; it consists of a cast-iron block in halves, having a reversed "V" near the top. In the slide as thus formed is fitted a piece of tool steel in such a manner that a portion is left extending above the top, while one end projects beyond the casting, and has, cut in it, a recess to engage with the collar on a screw tapped into the casting for the purpose of adjusting the steel piece longitudinally. The collar is also graduated on its periphery in such a manner that the operator can readily adjust to thousandths of an inch.

The steel piece is further secured by broad-pointed screws passing up through the bottom of block and acting similarly on it as a gib, or they may be tightened up so as to hold it fast.

This piece is drilled for the thread and sawed in two, the saw passing through the hole; both parts being replaced, the one held stationary while the other is adjusted to the hob, preferably a straight one, and the process of hobbing continued, gradually feeding the movable part by means of the graduated screw until a full thread is obtained. Both parts are then removed, the movable one relieved and shaped for cutting, tempered, replaced and adjusted to a screw plug gauge, a note being taken of the reading of graduations.

The rough cut taps are then run through, each time closing up the movable part until the proper size is reached; the part which is fast acting only as a rest and guide in the form of a fixed nut. By this means a very smooth and accurate thread is readily obtained and duplication rendered easy.

The fixture can be annealed and re-hobbed at a small expense at any time, thus possessing, along with the features of solidity and firmness, that of ready renewal as well as accurate adjustment.

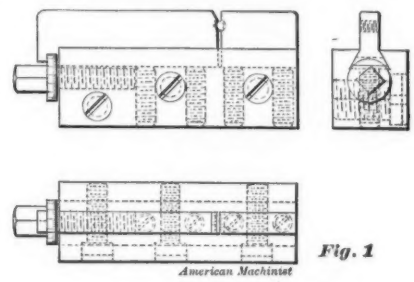


Fig. 1

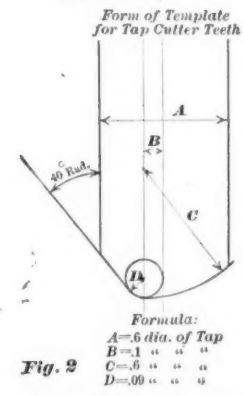
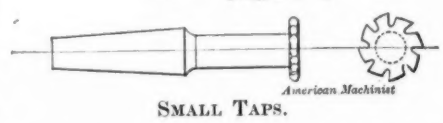


Fig. 2



Small Taps.

The form of the stem cutter used is given along with a formula, Fig. 2, for the shape of the teeth of cutters for any size of tap.

After milling and hardening, but before drawing the temper, the grooves are ground out with a small emery wheel, and the remaining burrs, if any, removed by a revolving brush made of fine wire.

On an average 90 per cent. of the taps made in this manner will make a hole within the prescribed limits of a quarter of a thousandth of an inch; those coming smaller being used for first or taper taps, while the larger ones do very well on ordinary work where such refinement is not required.

Letters from Practical Men.

Tightening Babbitt in a Solid Box.

Editor American Machinist:

One of your correspondents asks for a way to tighten babbitt in solid boxes. If he can put the work into a drill press that is already provided with boring bars, it is an easy matter. Fit two pieces of steel to any shaped hole through the bar, letting them meet in the middle fairly. Make their combined length not greater than the diameter of the cast hole. Finish the outer ends, rounding every way, harden and polish. Pack out with paper and go through several times at slow speed. If the work can't go in the press turn a plug one-half to size of cast hole and the other one-half to finished size. Make the "rubber" in one piece and wind through once by hand. As it is quite easy to burst a light hub by this process, some caution, and oil, and good sense should be used. Superannuated.

The Proper Method of Projection.

Editor American Machinist:

The arrangement of the different views upon a sheet of drawings, or the selection of the angle in which the object represented is supposed to be placed, forms a subject for discussion which, I suppose, will never be settled. The schools seem bent on teaching the first angle, and the shops equally bent on using the third, and the result is an endless supply of advocates for both. In machine drawing I was taught the orthodox school method, that is, to use the first angle. Luckily for me, however, in prior work in descriptive geometry it was an invariable rule of the instructor in charge that in working out problems *all* the angles should be used in regular rotation, and thus while the textbook employed the first angle exclusively the students became equally familiar with all and were prevented from looking upon any one angle as more "natural" than the others. With the second and fourth angles the plan and elevation are upon the same side of the ground line, and, in fact, are often superimposed upon one another, and it is not to be denied that the use of these angles introduces appreciable complications into the solution of problems while they are, of course, entirely unsuited to working plans, Mr. Palmer, to the contrary, notwithstanding. I think I am qualified to say, however, that this is not true of the third angle. To the student of descriptive geometry, accustomed to use both angles from the start, the first and third angles seem equally natural, and problems are solved as readily in one as the other. To those, however (and their name is legion), who have no knowledge of theoretical descriptive geometry, who do not have and do not need any conception of "planes of projection" and the rest, it is simply undeniable that the third angle seems the more natural, and drawings in that angle are the easier to explain to such men. Who has not seen the workman place his hand edgewise against the right-hand end of the side elevation and then at one movement turn it flat upon the paper and move it to the right over the end elevation to illustrate his conception of the mental process of making the views? The average man's conception of a side elevation of an object is that it is such a view as would be made when sitting down in front of it, with paper in hand *between the eye and the object*, and what is to be gained by endeavoring to force the far less simple, and to such men utterly unnatural conception of a plane of projection the other side of the object, and by what possible process of reasoning can anyone advocate for commercial work a system which places the front elevation of a locomotive against the tender and the rear elevation alongside the pilot?

There is another consideration which appeals most strongly to the draftsman. Making drawings is laborious work at best, and the far side of the board is the worst part of it to reach. The elevations as a rule contain the most work, and the third-angle method brings them near the bottom of the sheet where the work is the least laborious, and were the arguments for the two angles

to be reversed in force I very much think that considerations of personal comfort would lead the average draftsman to ignore logic altogether.

This consideration does not appeal to school draftsmen, because their consecutive hours at the drawing board are few, and especially because school drawings are usually upon small size sheets, but a few full days' work on double elephant paper will show its force to anyone.

It cannot but be deplored that in so many matters (of which this is one of the least important) the schools should be so little in touch with the shops, but deplorable as it is it is natural, and little or no prospect of improvement can be seen. When the classes graduate this spring the brightest members will be selected for the vacant tutorships. In a few years they will become assistant professors by promotion, and by this time, if not before, they will have definitely adopted teaching as their business for life, and meanwhile the tutorships which they have left behind will be filled again in the same way. With the teaching force constantly recruited in this manner, and with very few professors having ever done a day's commercial work in design or construction, it is not to be wondered at that a spirit is inculcated and methods of work perpetuated which, to say the least, do not increase the respect in which the schools are held. F. A. Halsey.

An English Treadle Lathe.

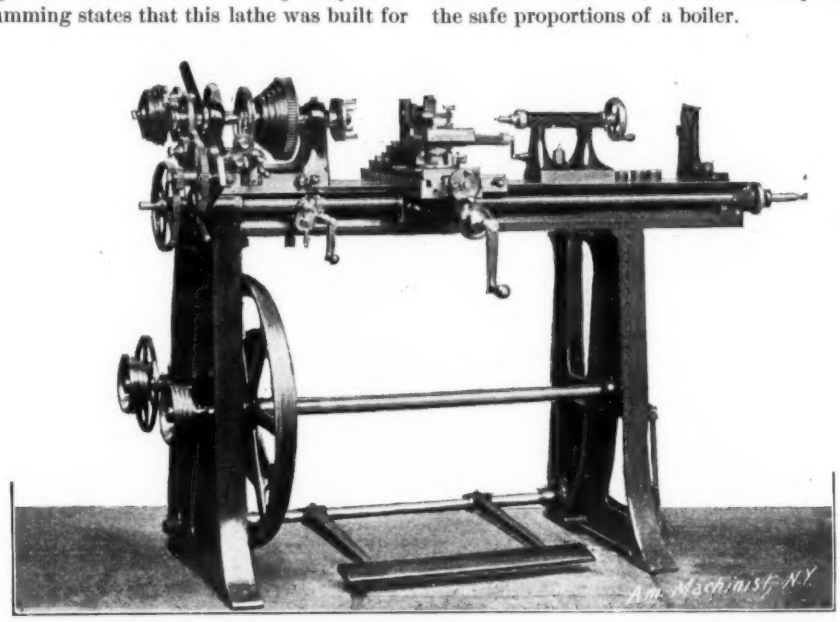
Editor American Machinist:

In reply to the letter of Mr. Raylance, in your issue of January 31st, I should like to inform him that I am the fortunate possessor of a lathe which—with trifling exceptions—has all the requirements he considers essential to a perfect tool, and which was built in his own town. My lathe, certainly, is of larger dimensions than the one he covets, but smaller sizes are, I believe, constructed by the makers with similar points of excellence. The lathe has a 5-foot bed and swings 13 inches over the gantry. The mandrel is 1¼ inches diameter, and could be bored out ⅜ inch if necessary, although mine has only a ⅛-inch hole clear through, as I use the splendid split chucks and draw tube made by the American Watch Tool Co., which require a $\frac{9}{16}$-inch hole only. The mandrel is of cast-steel and runs in collars of hardened steel ground and lapped, and the lathe runs with ideal smoothness. The index plate is attached to the face of the pulley, at the back of which is a large worm wheel, which, with a tangent screw and an arrangement of beautifully cut change wheels, constitutes a ready and reliable dividing engine. Your correspondent desires a 3 step cone and 1½ inch band to run his lathe, but I am quite satisfied with the 4 "veed" cone and $\frac{5}{16}$ inch round gut band which drives mine. The leading screw is 1¼ inches diameter and has 6 threads to the inch, the divided nut being 2⅜ inches long. My apron is certainly not of the "skeleton pattern," as I know—without seeing—"what is taking place behind it," and I prefer that the dirt and chips should keep *their* places—outside! The 14 pitch gears are cut from the solid, and are capable of producing screws from 3 to 64 threads per inch. The carriage bears 12 inches on each side of the bed. All the slides have depth [stop] screws. It is already fitted with a machine vise on the saddle, and has an "angle piece" to carry it and the slide rest vertical. The tail stock is not fitted with lever motion nor with a similar draw bar to the head stock, but these details—which are undoubtedly improvements—could be added without altering the patterns. The capital "Almond" turret head is fitted to it and works well. The main point of difference between the lathe I am describing and the ideal one so vainly sought after by your correspondent, is the price, as mine cost as many pounds as he wishes to pay dollars, but if he could show some evidence of the large demand for these tools that he speaks of, I have no doubt that the makers would turn out a thoroughly reliable tool for the sum quoted. My lathe was costly because it is finished to a degree of accuracy quite beyond what is required for ordinary work, as you will judge from the fact that the leading screw—carefully tested with a Board of Trade standard bar and microscopes in the slide rest—proved to be only .0009 inch out in the total length of 5 feet, and I may fairly say that the rest of the machine is up to sample, and in its workmanship and general accuracy is as perfect as can be produced—at any rate on this side of the Atlantic. In the photograph I send you, the unusual gearing behind the head stock is for connecting the front spindle with a second mandrel, used for purposes outside the usual requirements of an engineer. Your countryman, Mr. Clark, of "six cord" fame, took over a similar machine some years ago, I believe, and I have no doubt he will readily testify to its good character. The makers are Messrs. Birch & Co., of Manchester. I did not buy my lathe from them direct and have no interest in writing them up, beyond the universal wish to see honor given where it is due. Of course, the machine I have hastily described is a much more elaborate one than most engineers would require. In fact, it has so much apparatus fitted to it that an American friend who recently visited my workshop remarked, "that if I wished to use each attachment every day, I should have to get up very early in the morning"!

Mansfield Cumming.

Lyndhurst, Hampshire Co., England.

[In a letter written subsequently, Mr. Cumming states that this lathe was built for the late Mr. I. S. Kennedy, for many years the managing partner in Fairbairn, Kennedy & Naylor, a big firm of engineers in Yorkshire. By his request this lathe and the rest of his splendidly fitted up private workshop went to Mr. Cumming, who sends us also a photograph of the accessories, all systematically arranged upon shelves, and showing that everything that could possibly be desired in the way of accessories is there, including five different sizes of jaw chucks, three different sized face-plates, and innumerable attachments, the outfit of an enthusiast able to command the best tools obtainable. It will be noticed that there are two methods of turning the lead screw by hand (as shown at left of carriage), one squared shaft being attached to a worm and the other to a bevel pinion. These would not be considered necessary on an American lathe, and yet what American machinist has not had upon his hands the imprint of the threads of his lead screw "done in oil" by grasping the screw each side of the carriage to turn it slightly when the nut is closed and the carriage must be moved a short distance? Sometimes he goes to the head of the lathe and takes hold of the change wheel on the screw, but this is not always possible. —Ed.]



An English Treadle Lathe.

The Ultimate Strength of Boilers.

Editor American Machinist:

I was recently called upon by a friend to tell him "why steam boilers burst," he being at the head of a large business involving the use of many boilers of different types, and naturally anxious to observe such precautions as would render his property safe against such disaster. As the answer, you may realize, covered much ground, I do not intend to repeat it here, but there is one point which has for a long time been impressing itself upon my mind, and which I embodied in my reply, that may be called a theory, inasmuch as I can find very little written upon the subject confirming or disproving my views. The question is, what is the value, based upon the behavior, of steel or iron boiler plate loaded beyond its elastic limit? Most of the steel now being used in boilers possesses an elasticity limited by about 50 per cent. of the tensile strength, that is, the limit of elasticity in a plate of 60,000 pounds tensile strength will be about 30,000 pounds. Above that limit permanent "set" or distortion begins. Now, I may state it as a well-known fact that the results of the machine tests of a given sample may be varied so as to produce either greater tensile strength or show greater ductility. The element of time is the essence of the variation. That is to say, a piece tested rapidly will show a higher tensile strength and less ductility than one tested slowly, which will show a lower tensile strength and a marked increase in ductility. Boilers are under steam continually or nearly so, and the question in my mind has settled itself that *no value should be attached to tensile strength beyond the elastic limit* as a factor in computing the safe proportions of a boiler.

I am assisted strongly to this conclusion by the results of some experiments by Chas. Huston, published in *Journal of Franklin Institute* January, 1879, in which the specimens were subjected to loads to about the limit of elasticity, and kept there for 24 hours, when the load was increased at intervals of 24 hours, until the specimen broke. Under this treatment the test pieces broke at strains far below the tensile strength, under quick tests. His figures are:

Test 188 broke at 45,000 pounds to square inch; tensile strength 61,293 pounds.

Test 196 broke at 48,000 pounds to square inch; tensile strength 59,900 pounds.

Test 195 broke at 47,000 pounds; tensile strength 58,800 pounds.

Test 194 broke at 49,000 pounds; tensile strength 60,000 pounds; and test 189 broke at 49,000 pounds; tensile strength 66,415 pounds.

The vast reduction in the apparent strength of the material in these samples, the experiments upon which covered only a few days at most, would seem to me to indicate that under a continuing strain of perhaps months, the factor of safety assumed from a test completed in a few minutes is eminently fallacious, and it is this, upon which I have founded the opinion expressed above. Of course the adoption of such a view cuts the factor of safety based upon the tensile strength fairly in two, but if one-half of such a factor is based upon erroneous assumption it is best that we should know it, and correct it.

If you or your readers have any data bearing upon this matter, I think its publication in the columns of your valuable paper would be highly interesting and instructive. It is perhaps needless to add that my remarks apply wherever material of this class is under enduring strain.

Erie, Pa. H. R. Barnhurst.

A Thread-Cutting Suggestion.

Editor American Machinist:

While the use of the milling machine at the present time is certainly a very varied one, and the process of milling is applied to work formerly done on planers and lathes, there is yet one thing (and perhaps more) which could be done by milling. I think that it is possible to mill the threads of long screws.

Of course, I do not know whether or not screws are made, or have been made, by milling. I see no good reason why it should not be possible to use a revolving cutter for threading long and heavy screws, and thereby reduce the cost of production enough to warrant an experiment. Of course there would be difficulties, but I believe they could be overcome. Paul Heynig.

Freezing of Hot Water Pipes.

Editor American Machinist:

Mr. Frank Richards' question in your issue of March 14, 1895, coincides with a similar experience of mine. The pipes, in my case, ran close to each other, and the faucets in all the bowls were tight, yet the hot water would freeze up, and cold water pipe not.

On investigating, I found that a branch led from the cold water pipe to the tank that flushed the water closet, and the supply in that was controlled by a valve closed by a float in the usual manner, and it leaked just a trifle, not enough to hear, and very hard to see, but yet enough to keep a circulation in that pipe. It would seem to me that there must be something of the kind in Mr. Richards' case. H. P. Fairfield.

Cleveland, Ohio.

Belts on Cone Pulleys.

Editor American Machinist:

Observation convinces me that some persons who put up countershafts over machine tools do not seem to know that there is a right and a wrong way of doing this. Especially is this true when such machines are driven by a belt which requires shifting on cone pulleys.

Not unfrequently such shafts may be seen suspended directly over the workman—a position that carries the belt at an angle of 20 degrees or 30 degrees from a perpendicular in a wrong direction, as I think can be shown with but very little argument. In fact, all lathe hands who have had experience with belts leaning from them, and those arranged as I have described, will doubtless agree with me at once. All are aware that the manipulation of a belt when properly arranged is a very simple performance when the art is once acquired. As we sometimes say, "a simple flip of the hand and twist of the wrist" and the belt is changed, and that without the use of a pole, or any other contrivance.

But how is it when the belt leans toward the operator? The side of the belt that should be slack is tight, and flipping does no good. A pole must be found, or, as is sometimes done, a shifter stick is suspended by a hinge near the upper pulley, and with this the belt is forced from one step to another, and in the operation often suffers contortions which injure it more than all the legitimate service required of it. While on this subject it may not be amiss to speak of another troublesome "kink" met with in the use of belts, and one still more exasperating, perhaps, than that referred to. I allude to a persistent twisting tendency sometimes indulged in by a belt running on cone pulleys. A half turn of such a belt may be tolerated for a time, but when it assumes a corkscrew shape, and becomes as fine as five or six-inch pitch, something must be done.

To prevent such trouble, I have actually

seen a lathe spindle removed and a cut taken off the pulleys in order to make the faces of the steps more crowning. A simpler remedy is sometimes sought in the use of a pinch bar, and the lathe or other tool is yanked around first one way and then another until the belt is made to run free from the shoulder of the next larger step.

I am not supposing that the great mass of the readers of the AMERICAN MACHINIST are being enlightened by what I am saying, but should there be any one afflicted by the kind of perversity in belts which I have described, or regard their action with any degree of "superstition," to them I would say, unlace the belt and lay it on the floor. In place of laying straight, it will most likely present a curve or curves, with radii anywhere from 10 to 40 feet.

I believe the best remedy for such a worthless thing is to throw it away and get a double belt, or a good single one, cut from central portions of the leather and evenly stretched.

I have, however, when compelled to do so, found a remedy for the twisting by cutting out wedge-shaped pieces at suitable interstices in the curve in order to bring the belt comparatively straight when laced.

"QUIRK."

Calipers.

Editor American Machinist:

Of all machinists' small tools, perhaps calipers of different kinds are of the greatest importance, so the subject should be an interesting one to machinists. There are as many different patterns of calipers as there are opinions in regard to them, and there are plenty of both. It should be of considerable value, to, if possible, settle the matter of which is the best for the work, so I hope this subject will be continued until there is something good comes of it.

For rough measurements to be taken without stopping the lathe, I prefer spring calipers, but I do not do much of this sort of thing now, for it is difficult to know much of size in this way.

For fine measuring I prefer stiff calipers, and, so far, stiff calipers that I have seen are of the riveted kind, or, I believe, the *best* ones are.

I do not say that it is impossible to make calipers of the spring kind as rigid (as far as the pressure goes) as the riveted ones, but that it is not done, the fact being that spring calipers have been made with the idea of springing worked right into them. In your issue of January 31st, Mr. Carter tries to hold up the spring end of the argument. In the first place, he claims that I have said that spring calipers are only used on rough work. If Mr. Carter would read my article in your issue of January 3d (which it seems he has not done), he will find that I have not said anything of the kind.

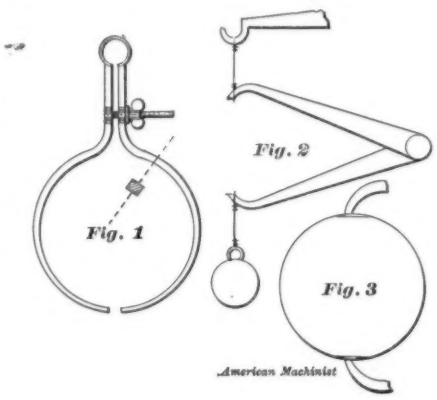
I said that in the making of standard plug and ring gauges, if spring calipers are used at all, it is only on the rougher part of the work, and might have said the same about rivet calipers.

I know well that there are machinist magicians, who can and do work quite closely with the springiest kind of spring calipers, but this is not saying anything in favor of the caliper, or the man who uses it, when he can get something better and does not. I used to think it a smart trick to measure closely with a spring caliper, but now I think it a very foolish trick.

Mr. Carter goes on and accuses me of showing up the *very worst* kind of spring calipers in order to keep the spring end down, and then showing the best form of rivet calipers to keep the rivet end up. Now, I do not like this, for it is not true. I have seen much worse spring calipers than those I furnished you a sketch of before, so in order to clear myself of this charge, I hope you will illustrate Fig. 1, which is the worst I have seen up to date, and I have great confidence in the rising generation not to produce anything worse. They say if a little sugar is sweet, that a "great large lump" is *very* sweet, so following this logic, Fig. 1 must be the king of spring calipers, and this is just what the proud owner thought of it.

The owner of this "double-breasted, all-wool and a yard wide" caliper was a blacksmith, and besides this, he owned two more of the same kind, and probably if he wanted any more this is the kind he would get, if possible—"it is so easy to get work right with them, does not need to be nearer than a sixteenth, you know." Now, this blacksmith had used these calipers 40 years or more, and the amount of bad work that could be traced directly to them would make up the strongest argument possible against spring calipers.

My first introduction to a machine shop was in a shop in the State of Maine, where



considerable saw-mill machinery was made and repaired, which included considerable shafting and pulleys, or rather flanges for wood pulleys.

There were a great many taper keys used in holding all of these pulleys, and at that time all of these keys were forged to wooden patterns furnished the blacksmith. The keyways in all pulleys were cut with cold chisel and file, and no attempt was made to keep them uniform, so every key had a good deal of personality about it.

The blacksmith who did all of this key forging was the party who handled Fig. 1, and the party who pushed the file that removed the stock that had been used to make the calipers spring enough to suit the blacksmith, was the one who got the worst of it, and that one I happened to be for a while, and this is one reason I have not forgotten about this little matter. I am not likely to forget it, neither am I likely to recommend Fig. 1 as an ideal caliper, unless I am anxious to increase the manual labor in machine shops.

I have seen machinists who could and did measure closely with calipers about as bad as these, but were they not doing a foolish thing? Blondin walked across Niagara Falls on a tight rope, but if he should insist upon crossing in this way, as a common practice, how many would not call him a fool? There is no reason why such calipers should ever have been made or used at all.

You often hear a machinist advise to get the lightest kind of calipers. I can agree in this to a certain extent, but these light calipers should combine rigidity with lightness, that is, they should be proportioned with regard to the strains.

A caliper with square cross-section of legs, as in Fig. 1, is not right, and the same can be said of a caliper with unnecessary length of legs, or unnecessary bow, which defects are all prominent in Fig. 1, which might have been made about ten times more rigid without increasing its weight or lessening its capacity, and this would mean that the same sense of touch on the part of the workman would have measured about ten times closer.

Mr. Carter says he can't see the logic in a rivet joint being stiff for a slight pressure, and the spring caliper springing too much with the same usage. I suppose the reason why he can't see logic in this is because it is not a matter of logic, but one of those cold, hard facts that we sometimes run against, and find more immovable than a mountain.

A friction joint only gives way when the pressure exceeds the friction, where the spring goes in proportion to the load, however light it may be, the weight of a feather will do the business. If Mr. Carter will examine a spring-weighing scale he will get a "starter" for correct logic.

I called attention in my last letter to the spring end of spring calipers, but I will admit I may have been in error in calling this the springiest part of some spring calipers. As the spring (or what is most intended for spring) of a spring caliper is under tension, perhaps it does not move further till the pressure has exceeded this tension, I am willing to let others decide about this, contenting myself in knowing that there is a great abundance of spring in all spring calipers, whether it be in the "spring" or the legs. Of course the rivet caliper will spring in the legs with a light pressure, but on account of their better proportion, they spring much less than spring calipers.

The caliper Mr. Carter shows as his ideal has the spring so arranged that it does not receive the pressure due to measuring, so I should say it lacked rigidity to the greatest extent in the legs below the adjusting screw; I have one of this kind of caliper that I believe is much better proportioned than the one shown by Mr. Carter. He says it looks ridiculous to see a man rapping his calipers in order to adjust them. Perhaps this is another case of "the mote in thy neighbor's eye." If a man does not want to rap his calipers to adjust them he need not; there are several ways to get over this. There are rivet calipers with screw adjustment for those who want them. I should not stick to rivet calipers particularly. What I really mean is rigid and light calipers. Up to date I believe the two kinds that there is the greatest gap between in this respect are the spring and the rivet kind.

If the only purpose of a caliper was for convenience in adjusting, I should give it a different form from anything I have yet seen, but this is not the case, one point in use being worth ten in adjusting. I have my rivet calipers go quite easily in the joint. A little pair that I use much for outside work is shown in Fig. 2. I find that the joint starts with seven ounces of pressure applied as the weight is acting in Fig. 2.

I find that a rivet caliper with quite a stiff joint, but not an uncommon kind, requires 2 pounds 10 ounces to start the joint in the same way. I rarely start these little friction calipers in use, and the joint being easy is a great help in adjusting, for a quite close size can be got instantly by pushing them over, and then they may be adjusted as fine as is required by simply pushing them over again when not exactly square with the work, which will open them a further amount, depending upon how much out of square they are held. I find this fully as quick and as fine an adjustment as in any spring calipers I have seen.

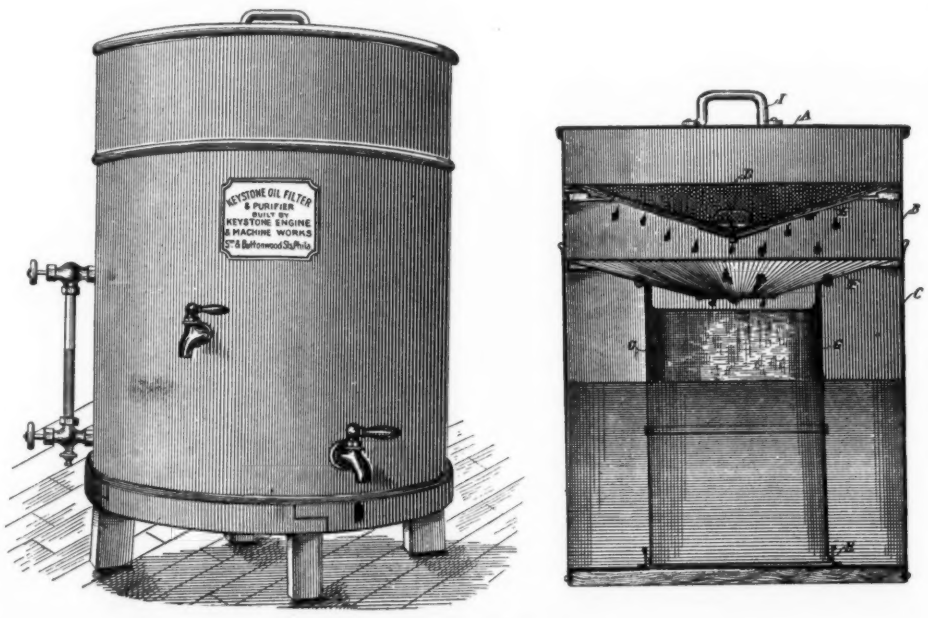
I tried some experiments to find the amount of difference in spring between these little rivet calipers and a Stubbs spring caliper that I have been the owner of (but not the proud owner of) for quite a number of years. The spring caliper was intended for about the same range as the rivet, and is a light form, but I found on weighing them that the spring weighed one-third ounce more than the rivet. On being suspended, as shown in Fig. 2, with a weight of four ounces, the spring caliper opened .007 inch, where, with the same treatment, the rivet caliper opened .0015 inch as measured with an inside micrometer caliper. This ought to tell quite a long story.

I don't pretend to tell how much pressure there is exerted between the points of calipers in good practice, but it is safe to say that it is greater than most people realize, for in calipering round work the caliper points rest upon the finest kind of wedges as shown in Fig. 3; the larger the diameter and the finer the limit of error required, the finer the wedge, and the greater the need of rigidity in the caliper.

I am of the opinion that most proprietors of machine shops could better afford to give free a micrometer caliper to each machinist, or have a number kept in the tool room to let out than to allow things to continue as they are going.

Perfect rigidity exists only in the minds of some people. The heaviest machine beds will spring a small amount with the slightest pressure. When Mr. Carter asks where his caliper lacks rigidity, he might be answered, all over, even were it 100 times as heavy, but this is not the real question, for that is: Where could it be best improved?

Providence, R. I. A MECHANIC.



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Oil Purifier and Storage Tank.

We present herewith engravings of an oil-purifying apparatus which is designed to work without the application of heat or water.

Half of the top is hinged and can be turned back to pour oil in. The oil first falls upon a coarse screen, which separates the coarser impurities, and from this it falls into the cone below and falls into the central settling chamber, the walls of which are made of an exceedingly fine woven fabric of brass wire. As the purified oil is drawn off from the main tank, gravity forces the other oil through this fabric.

Facilities are provided for conveniently cleaning the filter, it being made in sections with handles for convenient lifting. It is made in six sizes by the Keystone Engine and Machine Works, Fifth and Buttonwood streets, Philadelphia, Pa.

It is announced that capitalists "friendly to New York Central & West Shore Railroad interests" have acquired control of the principal line of steamers plying the Hudson River, and will "discontinue the ruinous cutting of passenger and freight rates" between New York and Albany and other Hudson River points. Two new and magnificent steamers will, it is said, be added to the fleet, and much faster time be made than by the present boats.

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Sickels, the Inventor.

We have little doubt that our readers will justify us in devoting so large a space in this issue to an account of Frederick E. Sickels. The article can hardly fail to prove interesting to readers of such a journal as this.

It is scarcely necessary to say that the search for facts connected with the life and work of this remarkable man was commenced and carried on by us without the least prejudice for, or against him, as an inventor or as a man.

When his death was announced we simply inquired of a few men likely to know something of him, what they could give us for publication regarding him. Their replies suggested other inquiries, and before we had gone very far in the matter it had become not a question of how much we could find regarding him that would be of interest, but how much of the interesting matter gathered together we could find room for.

As to the strife which arose between Sickels and Corliss, we give simply the facts as we have found them. As is well known, we have never been at all backward in according due honor to Geo. H. Corliss, either during his life-time or since its close. He was without a doubt one of the world's great engineers, and did much to advance steam-engineering practice. Wherein the account published in this issue seems to detract from his fame, all we can say is that we cannot help it. The facts are given as we have found them, and our sense of justice compels us either to publish them as found, or say nothing on the subject, and we have chosen the former alternative.

Men familiar with the case declare that the decision of the court in favor of Corliss hinged mainly, if not entirely, upon the assumption (supported by the testimony of experts) that the *spindle* of a cylindrical oscillating valve differed so much from the *stem* of a puppet valve that a drop cut-off arrangement applied to the former was not mechanically equivalent to such an arrangement applied to the latter form of valve. Everybody knows that this is exceedingly fine hair-splitting, and it is evident that if the decision was founded upon this assumption only, then the board of judges on steam machinery at the Centennial was justified in awarding to Sickels the credit of the invention of the drop cut-off, which Mr. Chas. T. Porter, in his exceedingly interesting letter, says they did do.

We have spared neither pains nor expense to obtain and publish either a fac-simile of this original award or a copy of it, believing there are many who, like Mr. Porter, would wish to see it made public, and Mr. Porter's letter is an ample comment upon the circumstances connected with the award. We hope yet to be able to publish the award.

His account of Sickels at the London exhibition shows the man in what appears a characteristic light—sacrificing or ignoring plain business principles for the sake of what most people would regard as a mere whim, but which seemed to him, no doubt, an important matter. His mind was concentrated upon the importance of the invention itself and he despised mere attractiveness of exterior—failing to see the importance of mere outward appearance in attracting the notice of the public, which was the real object of exhibiting his device.

Mr. Durfee, the historian of mechanical engineering, will in an early issue (possibly next week) take up the matter of Sickels' work from another standpoint, and will review briefly the famous legal contest which led to the final decision as to the scope of his patent on drop cut-offs.

Top-heavy Armor Clads.

Commenting upon the fate of the "Reina Regente," one of our great dailies mournfully calls attention to the fact that the lost vessel had a 5-inch steel protective deck and conning tower, and remarks that "such a deckload is necessarily a serious menace in a heavy sea, depriving the vessel that carries it of much of her buoyancy, and rendering her helpless in case of any accident to her machinery."

"The weight above water aggravates her rolling, and as soon as she rolls far enough to give entrance to the sea, she sinks like a shot, etc."

The dailies are scarcely expected to maintain a corps of specialists, capable of attacking the thousand and one branches of applied science that crop up for notice in the editorial department, but where specific allegation is to be made, persons having some sort of idea of the question in hand should be consulted, lest competent readers experience the languor that naturally follows the perusal of sockdological philosophy.

All vessels of the standard type carry their center of gravity *above* their buoyancy center, and are therefore top-heavy in the usual acceptation of that term. But by reason of the form given to the underwater body the upsetting tendency is far more than counteracted by the shifting of the center of buoyancy towards the danger side when the action of wind or weight tends to heel the ship.

The total weight of vessel is balanced by the upward pressure of the water, and this is the case without regard to heft or lightness, which are simply relative terms.

The armored ship is given increased underwater dimensions to carry her extra total load, and, unit for unit, is exactly as buoyant as the lightest "paper shell."

Designed and constructed by competent hands, the armored ship is the safer of the two types in heavy weather, for the shock of a sea that would crush the lighter vessel's side, is absorbed by the local mass of metal, and the resulting strain of the main structure is far less.

With the same freeboard, the regular armor clad will float as long as the "paper shell," when injured below water, the exception being the American monitor, which, by reason of having so little spare internal space—the *overhang* of armor reducing the unit capacity per unit product of over-all dimensions—would go down much quicker than a hull of light scantlings built to the same total length and beam.

That many iron clads *are* top-heavy there is no question, but the same mark of incompetent design was observed in certain of our own "marvels of construction," of the most pronounced feather type.

It is scarcely necessary to call upon the oldest inhabitant to get information as to the cutting in two, lengthening and the filling in of the lower portions with cement and pig-iron, of various crack cruisers of the U. S. Navy. If the "Reina Regente" foundered for want of stability, the blame should be laid to her particular combination of qualities—design—and not to her mere total load, and also, it should not be lost sight of that the finest ship that ever floated is liable to go down in a hurricane, unless handled according to the principles of sound seamanship.

Trolley Competition.

There is little doubt but that the suburban trolley lines of railroads are going to be very formidable competitors of the steam railroads for local business in the more thickly peopled portions of the country, and some of the companies operating steam roads in Connecticut are evidently beginning to feel the competition very keenly. Their officers are therefore asking that the electric roads be placed under the same restrictions as the steam roads, and that proposed parallel roads be prohibited. But it is to be remembered that if the people are abandoning the steam roads for the electric roads when they wish to ride short distances it must be because the latter give the most satisfactory service, and it would seem to us as though this advantage to the people will not be easily given up by them. Nor should it be. But the two kinds of roads should be placed, we think, upon an equal footing; and then, let the best win. It is a fact that most of the electric roads have paid absolutely nothing either for their right of way or for the construction of road-bed. They have simply taken possession of the public's right of way, and have laid their cross ties and rails upon a road-bed already graded free of cost to them. Not only are they relieved of the necessity for earning dividends upon this cost, but they have no taxes to pay upon this valuation. The steam roads have had to buy their right of way and then pay for construction of the road-bed. Then they are taxed, or at least supposed to be taxed, upon this valuation, in addition to the taxes laid upon their other property, while in the case of the electric roads the people not only do not tax them upon this valuation, but actually give it to them free of charge. There are other differences, of course, between the two roads, but this is the public's difference in the treatment of them, and it seems hardly fair. Under the circumstances probably the best possible way to correct the evil would be to require the trolley lines to pay into the public treasury something like the value of their franchises annually.

An officer of the New Haven road recently stated that his road had suffered a loss of from 30 to 90 per cent. of its local passenger traffic between certain points, but so far as we can learn had nothing to say as to the increase of passenger traffic caused by these same lines of roads acting as feeders to the steam roads, which they undoubtedly do to a very great extent. At the same time, this same road is taking perhaps the most advanced position with regard to the use of the electric motor on its own lines, and is said to be about to make some tests of the matter upon branch lines where trains are few and other conditions favorable. It is thought that electricity may be quite generally used on these branches. The talk about displacing the steam locomotive on the main line is, however, entirely premature in our opinion. There may be officials who think it will be done soon, but there are probably other officials, whose opinions on that point are more worthy of consideration, who do not think so.

Foreign Castings at Exhibitions.

We have before us a letter which seems to throw light upon what has been somewhat of a mystery. This letter was not written for publication, but is from an American machinist, at present employed in a European establishment, addressed to a friend in this country. He says: "I made quite an extended trip in France a few weeks ago and visited several shops that are very well fitted up, but I failed to see any of the work that Professor Sweet tells about, that was done so well that no American could tell how it was done. It is true that some of the machines exhibited in Paris in 1889 had very smooth castings as he said, but the entire casting was filed all over before it was painted. We have machines in stock now that were shown at the Paris Exhibition in 1889, with remarkably smooth castings, but every part of the machine, even to the counterweight inside of the bed has been filed thoroughly before painting, and some parts of the bed were machined where there was too much to file." This seems to again illustrate the familiar fact that all is not gold that glitters, and that there are others besides Chinamen whose ways are dark and whose tricks are vain. It is exceedingly doubtful if there was a single American machine exhibited at Chicago the castings of which had been filed or machined all over before painting, though we are not so sure about thick coats of paint laid on in such a way as to conceal defects. The fact is that it is practically impossible to judge of a casting without seeing the casting itself, and to judge of the surface of a casting by the surface of paint upon it, is to expose one's self to the charge of being rather too trustful; especially at exhibitions of machinery.

One of the "national" building and loan associations recently announced to stockholders that its general offices would be transferred to Canada, whereupon many of them, very wisely we think, withdrew from the association.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(128) J. C. K., Albia, Iowa, writes': I want a practical manual of the telephone, a book that a man who wants to learn this *trade*, and not the science alone, should study. Kindly recommend such a book and give publisher's name and the price. *A.*—"Practical Information for Telephonists," by T. D. Lockwood, published by the W. J. Johnston Co., 253 Broadway, New York; price of book $1, may suit your purpose.

(129) C. J. F., Williamsport, Pa., writes: Kindly inform me where I can obtain a treatise treating on nickel electro-plating; also a work treating on the process of metal brazing. *A.*—For nickel electro-plating get "Electro Deposition of Metals," by Dr. George Langbein, published by Henry Carey Baird & Co., Philadelphia, Pa. We do not know of any book which treats specially on metal brazing.

(130) T. M., Newark, N. J., asks: What size plunger should be used with a 4-inch steam pump for boiler feeding? *A.*—A 2¼-inch water piston. 2. What are proper proportions for a compound engine having a 4-inch H. P. piston, 70 pounds steam, 6-inch stroke and 40 revolutions? *A.*—The proportions would have to be worked out for any but rough purposes, a 6-inch to 8-inch diameter of L. P. cylinder would probably suit your purposes.

(131) H. S., Thompson, Pa., asks: Is there any power in a fly wheel, whether attached to engine or any other piece of machinery? *A.*—As we have stated many times before, there may be energy in a fly wheel, but only when it has been put there by some other force acting upon it. A fly wheel cannot of itself generate power or create energy. It can simply give out energy which may have been stored in it from some other source.

(132) F. H. D., Chicago, asks: How do you lay out a triple-ported slide valve for a triple-expansion engine to cut off at one-third stroke? I understand the Zeuner diagram, but when I lay the valve out by it to cut off at one-third, the exhaust closes before the piston has reached about five-eighths stroke. *A.*—A slide valve driven by eccentrics cannot be made to perform satisfactorily with a cut-off shorter than about five-eighths stroke. Your best plan is to use a Meyer cut-off gear.

(133) W. W., Buda, Ill., writes: We have difficulty in keeping tight a joint in the supply pipe leading from a tank to a hydraulic crane. When the water is shut off the water hammer tends to loosen the joint. We have a relief valve on this pipe, but it does not do much good. Can we put an air chamber on this pipe, and will it help us any, if so, what size should it be? The supply pipe is 6 inches diameter. *A.*—An air chamber will help you, it should contain a volume of about 3 cubic feet.

(134) Amateur, Mt. Carmel, Ill., asks: What is the price of aluminum per pound? *A.*—From 55 to 63 cents, according to quality and in small lots. 2. What is the composition of the alloy for steam cocks, valves, etc.? *A.*—The following we believe to be a good composition for brass castings subjected to steam pressure: 20 pounds of copper, 1¼ pounds of tin, 1 pound of lead, and 1 pound of zinc. 3. How are cuts for machinery tools, etc., made for printing? *A.*—These are made in several ways; they may be engraved on wood; they may be made by the half-tone process, or by the wax process, or for very cheap work they can be made by a photographic process, the latter is suitable to line work only.

(135) W H., La Grange, Ill., asks: What is the best method of making a face-plate for a lathe chuck, should it be first bored out, threaded to fit the lathe and then turned to fit the chuck, or should it be first roughed out, then fitted to the chuck and then finished while in the chuck, the jaws of the chuck being at the same time tightened upon a true piece of work in the lathe? *A.*—We think the latter method is very much preferable. The reasons for this were given in an article published in our columns a number of years ago, but they will be evident upon a little consideration, the main advantage being that the thread is by this method cut and the end of the hub faced, while the working faces of the chuck jaws are also necessarily true, and at the same time strained up as they will be when the chuck is afterwards used.

(136) J. M., Woonsocket, R. I., writes: I have a problem upon which many others may have been similarly exercised. If you can help me to a simple and effective way of determining the power to a driven shaft at a known speed I shall appreciate it very much. I am asked to determine the amount of horse-power used by a firm hiring power from an adjoining concern, I cannot have access to the plant of the firm supplying the power, so I must avail myself of mechanical means to ascertain the amount of power used by the firm hiring. The members of this firm believe that they are paying for more power than they are using, while the other concern claims that more power is supplied than is being paid for. Matters between these parties will not admit of mutual helpfulness to arrive at results by using an indicator. *A.*—There are dynamometers made for measuring the power transmitted, and which will answer your purpose. They can be attached to the shaft which receives the power from the firm supplying it; the construction of some of these dynamometers is such that they can be attached to the shaft permanently, and the power transmitted read off at any time.

(137) J. J. S., Galt, Ont., asks: Will a given quantity of steam passed through an engine, and then turned into a system of heating pipes, heat the building to the same degree as if led from boilers directly into the pipes alone; in other words, is heat actually converted into work, and, if so, will you explain the process? *A.*—The total heat left in the steam after passing through the engine will be equal to the original amount imparted by the boiler, less the heat equivalent of the work done in the engine (radiation losses while in engine will also, of course, reduce the final amount), and therefore the heating effect due to passing it on through the coils will be less—by the amount consumed—than if led directly from boiler. The accepted theory of gaseous pressure is that it is due to the impact of the minute particles, this hypothesis having been found to explain most of the phenomena of unlimited expansion, etc., and a given weight of gas (steam or other) inclosed in a cylinder gives out, and therefore loses its kinetic energy to a moving piston in the same way that the energy of a blow is absorbed by a cushion or object moving *away* from the impact. Absolute temperature is a measure of the kinetic energy of a substance, for each given state or condition, and the absorption of such kinetic energy by a piston or other device, lowers the temperature and reduces the total heat.

(138) P. K., Botsford, Conn., asks: How much of a load can a man lift with a screw 1⅛ inches diameter, 4 threads per inch, the screw is turned by the means of a hand wheel 26 inches in diameter? *A.*—The circumference of the hand wheel is 81.68 inches, assuming that the man can exert a force of 50 pounds on the circumference of the wheel, then during one turn of the wheel an energy of $81.68 \times 50 = 4{,}084$ inch-pounds will be expended. Since the screw has 4 threads per inch, the distance through which the resistance will be overcome while the screw makes one turn, will be ¼ inch, hence, if there is no friction, the pressure on the screw will be $4{,}084 \div \frac{1}{4} = 12{,}336$ pounds. The friction will take up in this case about 60 per cent. of the energy exerted, leaving 40 per cent. only for useful work. Hence the pressure exerted by the screw will be $12{,}336 \times .40 = 4{,}934.4$ pounds. 2. There are five of these screws placed in a cast-iron head of a press, they are placed in a straight line at a distance of 4 inches between centers, distance between centers of supports, 20 inches, what should be cross-sectional area of the head which is tapped for the screws, also, what should be the cross sectional area of the same head when nuts 2¼ inches outside diameter are inserted for the screws? *A.*—If the head is to be rectangular in form, without any nuts inserted, its depth should be 4 inches, and its width 5⅜ inches; with nuts, 4 inches deep, and 6¼ inches wide.

(139) J. C. D., Chicago, Ill., asks: Is it possible to transmit 20 horse-power through a 6-inch belt running over 30-inch pulleys which make 165 revolutions per minute? We have had 50 cards taken off the engine, and when figured by experts the cards show all the way from 16 to 20 horse-power consumed by our department. We cannot dispute the figures given as we are not familiar with figuring the cards taken by the indicator. Still we fail to see how a 6-inch belt traveling at the velocity above named can transmit 20 horse-power, when all the calculations laid down by manufacturers and others give 15 horse-power transmitted by the belt. The engine furnishing the power, and from which the cards were taken, is a 12 x12-inch engine, running at the rate of 165 revolutions per minute, with 80 pounds boiler pressure. It is claimed that 33 horse-power is developed by this engine; is this right? Please give us such information on this subject as you can. *A.*—The rules to which you refer for computing the horse-power transmitted by belts give the horse-power which a belt should transmit with safety and not the ultimate horse-power which a belt can transmit; it is therefore quite possible that your belt does transmit 20 horse-power, although this overstrains the belt. The engine is quite capable of developing 33 horse-power, indeed it should develop more. Your trouble is probably in your line shafting, which may be out of line, and the belts may be stretched too tightly on the pulleys, which is evidently the case with the 6-inch belt. All this is liable to waste power. Our advice is to call in a competent mechanical engineer to examine the plant, he may suggest such changes as may turn out to be profitable to you.

(140) D. E., Youngstown, Ohio, writes: I would like to know how much pressure per square inch it will take to shear the threads from 7⅞ inches pipe. The flange and pipe of wrought-iron, and strong enough to bear the pressure. If there is a formula for calculating the above for various metals, and different pitches of thread, please furnish it. *A.*—If the flange is thick and stiff, the bolts being close to pipe, the strength will be practically the shearing strength of the weakest metal of the combination. This assumes that the threads are well fitted so that there is no particular play for breaking forces to act. Multiply the circumference of middle diameter of thread, by *half* the axial length of threaded portion (a V-thread being here assumed), the product is the shearing area. Multiply this shearing area by the shearing value of the metal, and the product is the desired *total* force. The *working* stresses for metals are as follows: Cast-iron, 2,200 pounds; wrought-iron, 6,500 pounds; mild steel, 10,000 pounds; cast-steel, 13,000 pounds; rolled copper, 1,500 pounds; gun metal bronze, 2,500 pounds. If the pipe is thin, and liable to crumple under great strain, the above must be somewhat reduced, as also if the flange is likely to bulge. Individual judgment alone can decide such allowances. Divide the total force allowable on the threads by the area of pipe. The quotient will be the pressure per unit of such area that will produce the necessary pull. A straight pipe, without blank flanges, will experience no pull, unless the ends be secured to unanchored parts, but the flanges and pipe should be amply strong, as uneven bolting of flanges, and temperature changes, are liable to produce great stresses. For the pressure necessary to actually tear off the flange there is no reliable formula. A rough approximation can be had by taking about six times the above given values of metals.

(141) A. B. C., Spokane, Wash., writes: Please show, by examples, how the horse-power of a boiler is computed; also how the heating surfaces in locomotive boilers and tubular boilers set in brickwork are computed. *A.*—The heating surface in all kinds of boilers is made up of the plates or portions of plates which come in contact with the water on one side and heat on the other side of the plate; hence the heating surface is computed by finding the area in square feet of each plate or portions of a plate which constitute the heating surface as stated above; the sum of these areas will be the required heating surface. These areas are found by the simplest rules of mensuration. If it is a rectangular plate, we simply multiply the length and breadth in feet of its surface, or that portion of the plate which constitutes the heating surface. In computing the heating surface of tubes, it is customary to take outer surface of the tube, because the size of tubes is generally given by the diameter of the outer surface, and seldom contains inconvenient fractions; hence to find the heating surface of the tubes multiply the outer circumference of a tube in feet by the length in feet between tube sheets and by the number of tubes; the result will be the heating surface of the tubes in square feet. The term "horse-power of a boiler" is a very indefinite one, and then, again, the rate of evaporation per square foot of heating surface for different kinds of boilers varies within such wide limits as to practically render worthless the rules bearing on the subject. But since it is convenient for boilermakers to have some means of rating the horse-power of boilers, the following proportions are frequently adopted: Water tube boilers, 10 to 12 square feet; tubular boilers, 14 to 18 square feet; flue boilers, 8 to 12 square feet; plain cylinder boilers, 6 to 10 square feet; locomotive boilers from 12 to 16 square feet; and vertical tubular boilers 15 to 20 square feet of heating surface per horse-power. It is, however, far more satisfactory to rate the boiler by the amount of water evaporated per hour The standard adopted by the American Society of Mechanical Engineers is 34½ pounds of water evaporated from and at 212 degrees per hour. The method of computing the horse-power of a boiler according to this standard is fully explained in our issue of December 6, 1894, answer to Question 558.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see page 272.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patents, H. F. Parker, Att'y, 26 Cort'ndt St., N.Y.

Cam-Milling. Machine Tool Works, Newark, N.J.

Marine Iron Works, Chicago (new catalog).

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Engine Castings, 1 to 6 Horse-power Vertical. The Humphrey Foundry, Bellefontaine, Ohio.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

American packing rings are in touch with the cylinder. New circular about rings and pistons. J. H. Dunbar, Youngstown, O.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

Emery, emery wheels, grinding machines and grinders' supplies, quick process and large stock. When in a hurry, buy of The Tanite Co., New York City, Cincinnati, Ohio, and Stroudsburg, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

B. C. Davis, Counsellor at Law,
186 Remsen street, Brooklyn, N. Y.
Corporations and syndicates, organized to develop industrial and business enterprises, financially shaped and floated.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

"Modern Locomotive Construction." By J. G. A. Meyer. In this book the design and construction of all details of the locomotive and tender are considered from a practical standpoint. It contains illustrations of details made from working drawings, accompanied by plain directions for designing, and rules and tables for construction. Adapted to office and shop use. Price, $10. Published by John Wiley & Sons, 53 East Tenth street, New York.

Shop Notes—The Jones & Lamson Shops.

Springfield, Vermont, is best known to machinists as the home of the "flat turret lathe," although the place is famous in other respects, notably as the basis and inspiration of Hoyt's comedy of "A Temperance Town"—a distinction which its citizens do not particularly plume themselves upon—but consider rather in the light of a slander. The most unique feature of the place perhaps is a negative one, and consists in the entire absence of railroads, the nearest passenger station being six miles away across the Connecticut River, and in the adjoining State of New Hampshire, at Charlestown. There is a regular stage line, however, which, at the time of my visit, was on runners, and a sleigh ride through such a picturesque and beautiful country as lies all about Charlestown and Springfield is certainly a very enjoyable affair. Springfield's freight station is somewhat nearer—about four and a half miles—and goods are transported by regular caravan teams.

This seems like a strange location for a town in which considerable manufacturing is done, but Springfield seems to keep her place, nevertheless, and moreover is a very attractive and enterprising town, of some 3,500 inhabitants, nearly all of whom are genuine New Englanders—intelligent, physically and mentally active, steady and resourceful. A new and most excellent hotel is here, and the degree of interest taken in educational matters is shown by the fact that $38,000 will be spent this season in the erection of a new public school building.

It is no part of my business to boom the town, but when a manufacturing establishment doing business all over the country, and in foreign countries as well, locates so far from any transportation line, it is interesting to study the reasons for it, and amongst the reasons, in the case of the Jones & Lamson Co., is undoubtedly the attract-

iveness of Springfield itself, added to the fact that Messrs. Amasa Woolson and Adna Brown, who were principal owners of the business in 1888, when it was moved here from Windsor, Vt., had been for years residents of Springfield, and were especially interested in the development of their town. Then Mr. W. D. Woolson, who is now the

The Jones & Lamson Shops.

principal owner and its treasurer, while disclaiming any intention to make invidious comparisons, gives the further reason that in his opinion the class of men that are obtainable there, and that *stay* there, form a distinct attraction, being steady, self-respecting, ambitious, good citizens, interested in their work, and appreciative of fair treatment; an opinion which was confirmed by my own very pleasant, though all too brief, intercourse with them.

The caravan teams before mentioned haul freight to or from the railroad at $1 per ton; water-power reduces the coal haulage to that required for heating only, and on machines billed at two tons in order to get them into a classification to which their actual weight (which is somewhat less) would not admit them, the charges are thus $2, with probably as much more upon the materials of which they are composed. This upon machines worth about $1,200 is not a heavy percentage, and is easily overcome by other considerations.

It is probable, however, that a railroad will be built before long which will take the place of the caravans, and it is designed to make it standard gauge so that regular freight cars can be taken over it, though electric motors will be used, and the current probably taken from an overhead wire; the stream which drives the Jones & Lamson water wheel furnishing also the power for the generators.

The Jones & Lamson establishment is one of the pioneers in the machine tool business in this country, and built the first turret head screw machines in 1855. The shops and their equipment at Springfield are, however, quite modern, and the methods followed in them savor as little of antiquity as the most advanced practitioner could desire.

As is usually the case with rejuvenated machine shops, this present condition of efficiency has not been arrived at without some vicissitudes, and six years ago when Mr. Hartness, a comparatively unknown mechanic, came there with his new and somewhat revolutionary ideas regarding turret-lathe construction, and proposed to take charge of the mechanical part of the business, he very discreetly insisted upon a contract covering three years, knowing full well and frankly avowing that at the end of the first year they would want to get rid of him, and probably would do so in the absence of a contract designed especially to prevent such premature action.

His expectations were fully realized in this respect. At the end of the first year things had been thoroughly turned upside down and the balance was apparently on the wrong side. But Mr. Hartness was confident that if the real values of the plant at the beginning and at the end of the year could have been taken into account a good showing would have been made, and he persevered. He is now the manager and superintendent, and is patentee of many turret-lathe inventions, twelve of which are on the flat turret lathe, the manufacture and sale of which constitute nearly nine-tenths of the business.

As showing the effect in this instance of adopting what are called the advanced methods, it is interesting to note that the organization under "drafting-room direction," which called for an apparent increase in labor by the addition of draftsmen and jig-makers in the shop, has steadily reduced the cost of production till it now stands 64 per cent. of the amount paid in 1888, while the standard of workmanship has been gradually elevated.

The object of my visit to these shops was to see a new development in the line of turret tools, which will be described later, but before doing so it may prove interesting to give some account of a few of the other things seen in the shops—glimpse here and

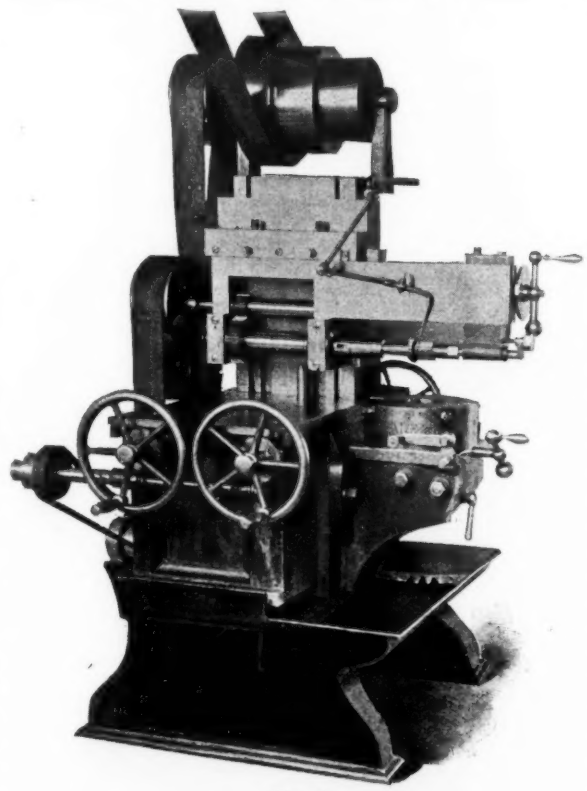


Fig. 1.
Milling Machine Built in '52.

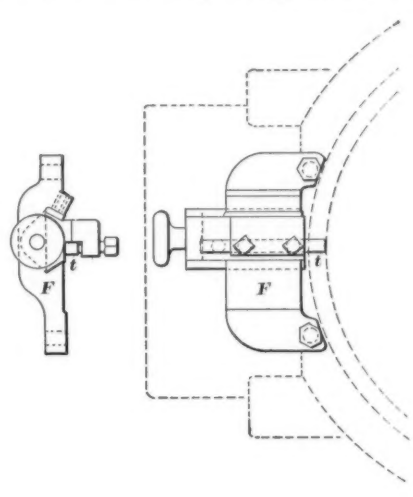
there that will serve to indicate the general practice.

A considerable portion of the building is new, having been completed about the time the recent business depression set in, on account of which it is not as fully occupied as it might have been otherwise. It is two stories high, of frame, built upon the "slow burning" plan, and with the flooring omitted through the center of the upper floor, thus leaving this open for the present, practically the same as though built upon the gallery plan. The floor beams are, however, in place across the opening, and do not much obstruct the light, while if the additional floor space should be needed it will be necessary only to lay the flooring over them. Under these beams is a small Yale & Towne hand-power traveling crane, nothing more than this in the way of a crane being required where the heaviest machine built, or expected to be built, weighs only about two tons. Automatic sprinklers give additional security against fire, and the lighting is by incandescent lamps. The dynamo for these gets its power from the same source—a duplex Leffel water wheel placed upon a horizontal shaft, taking water at each end and discharging in the center, so that there is no end thrust to provide for. A hundred horse-power (about) is developed, and a manilla rope drive conveys it to the line shaft in the shop.

Beds are milled off on top after being first planed, and two milling cuts are taken over them, a gang of roughing and a gang of finishing cutters being used, each of which covers the entire upper surfaces, including the outer edges, and about $\frac{1}{16}$ inch is milled off. This work is, of course, done with very modern milling machines, the appearance of which would be familiar to our readers, but at Fig. 1 is shown a reproduction of a milling machine which is not so familiar, but is interesting as an example of early milling machine construction—interesting especially when it is considered that this machine, built in 1852, is still at work, and, though it obviously has its faults when compared with the practice of to-day, a good deal of work is found in the Jones & Lamson shops which it can do in an efficient manner. The machine was designed by Fred. W. Howe, who was a very well-known and very able mechanic of that time. It was built by Robbins & Lawrence, at Windsor, Vt., where, in those days, guns and gun machinery were made and good work was turned out. To the bed, of box form, is fitted in front a saddle which has a horizontal movement (by hand or automatic) and carries a knee which can be tilted 15 or 20 degrees either way from the horizontal position and secured by bolts passing through curved slots. The knee supports the index, which can be rotated by the crank handle shown at the right, and can also be clamped in any position. To the face of the upright is fitted a saddle which has a vertical movement, and to this saddle is fitted the overhanging arm, this arm having a short horizontal movement for adjustment of cut. It has automatic, vertical and horizontal feeds, is well finished—much more liberally finished than is the custom now, but except for this, the paneling in the bed and the numerous square corners, has quite a modern appearance. Its designer certainly had advanced ideas for his time, and I think that some milling machines inferior to this one have been built within the past five years. The disk, with graduations for indicating the horizontal movement of the cutter, is a recent addition, but in other respects the machine is as it was originally built.

In the manufacture of the flat turret lathe, the different parts of the work are divided and placed under different foremen, the heads being made in one department, the carriages and turrets in another, etc. All small parts are made in great numbers, and by the use of the shop's own product so far as possible, these parts being finished and placed in suitable bins in a store room, the keeper of which receives a memorandum of each shop order, and by consulting an album made up of blue prints of these small parts, accompanied with the needful information regarding the number to each machine, etc., he assembles them in lots and delivers to each foreman the required number of pieces for each order, charging them against that order for the benefit of the costs' clerk.

Remarkable cuts are taken by these flat turret lathes here, particularly in forming handles in such work where a tool wide enough to cover the entire length of the handle is fed straight into the work by a lever which moves a slide arranged in a special fixture on the turret, the rest being also on the turret, so that the work, the turret and tool are rigidly tied together, and no one of them can possibly yield without also moving the others. The machine in which a cut is taken in this way need not be itself very rigid, but that the machine possesses rigidity and strength in a remarkable degree, was demonstrated by putting through the spindle of one of them a 2-inch round bar of Park Bros. "Corona" steel, 27 points carbon, letting it project from the chuck 14 inches without any other support whatever, and then reducing it to $1\frac{3}{8}$ inches diameter at a feed of 64 per inch, using a single tool cutting in the same manner as a lathe tool, though held in the



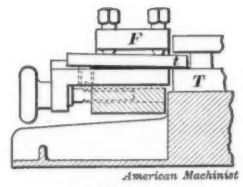


Fig. 2
A Special Slide Rest.

turret. The chuck in this case was the regular split-collet chuck, regularly furnished with the machine, and the bar was supported or held in no other way. This, of course, is far beyond what the machine is supposed to be called upon to do in regular service, and no one could, I think, see such a cut taken by the machine without some apprehension of a wreck, but there was no sign of distress in this instance, though, of course, the work was not driven at regular speed, because the driving power was not sufficient for such a cut at regular speed, and the intention was simply to show the strength and rigidity of the machine, even far beyond the requirements of its ordinary or legitimate work; for when working in the regular manner the work is held in a rest almost if not directly opposite the cutting tool, thus relieving both turret and spindle bearings of most of the stress they would otherwise bear. In another case I saw shorter pieces of steel held in a special chuck, and reduced from $4\frac{1}{4}$ inches to $3\frac{7}{16}$ inches diameter at a single cut at 90 per inch feed. This case was one of the regular operations of one of the flat turret lathes in use on their own work.

That quality in machine tools which enables them to take heavy cuts without flinching—usually called stiffness, is probably as much due to good fitting as to good design. That the former is looked after in the Jones & Lamson shops, is shown by their manner of dealing with two jobs which

are fairly representative. The turrets are formed as indicated at Fig. 2, where *T* is a small part of the turret, the rest of which is broken away. After this turret is turned, it is then fitted to its seat on the saddle by scraping, and as a gib fits over the surface which is being faced by the tool *t*, it is important that this surface should be precisely true with the bottom which has been scraped. The turret is therefore put in place upon the saddle where it is to work, the facing device *F* bolted to the saddle and the facing proceeded with, a simple attachment enabling the necessary rotary movement to be given the turret—said simple attachment being a wooden lever bolted across the top of the turret, projecting at each side and kept in motion by a workman.

In another case a turret slide was being scraped, and instead of simply scraping it to

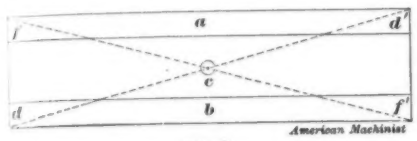


Fig. 3

A STRAIGHT-EDGE APPLICATION.

the block and depending mostly upon the planer for its being true and "out of wind," a plan was in use that seems a novel one, and the principle of which is shown at Fig. 3, where, supposing the sliding surfaces *a* and *b* which are raised above the general surface of the casting are to be scraped true, a center punch mark is made at *c* and a straight edge is used that has, tapped through it at the center of its length, a fine threaded screw with a point like a lathe center. This straight edge is applied diagonally, first one way and then the other, with the point of the screw referred to resting in the center punch mark. Supposing it to be applied first on the line *d d'*, and the screw at *c* adjusted so that when the straight edge is pressed to the surface at *d* very fine tissue paper can be just pulled from under it at *d'*, then when it will do the same on line *f f'* without changing the adjustment of the screw, all four points *f d f' d* must be in the same plane, or, in shop terms, be out of wind, and this condition is secured by scraping first at the four corners, after which the surfaces between the corners on each side are scraped to agree with this. The geometries say that two straight lines that intersect each other are in the same plane. I did not ask Mr. Constantine, who does this job and who is responsible for the method, whether or not he was acquainted with this geometric principle, but it is evident that he has a practical understanding of the principle, and makes a practical application of it.

With the natural pride of a true mechanic in his work, Mr. Constantine shows a set of straight edges of cast-iron ribbed to give them stiffness, 42 inches long, 2½ inches wide. There are three of them which were made together, and when one is placed top of another and moved gently back and forth upon the air film until there is no air between them, they are seen to fit very accurately; then a hair measuring three-fourths of a thousandth in diameter placed between them allows the upper one to swing freely in a horizontal plane with this hair as the pivot, showing not only accuracy, but a very creditable degree of stiffness as well, because it is evident that if the upper straight edge had deflected about half a thousandth it would not have turned so freely.

In the drafting room, where Mr. E. R. Fellows has charge, a good camera forms part of the equipment, and one of its uses is in reducing drawings made on sheets 20 inches by 24 inches to a size which trims to 9 inches by 11 inches, the negative made by the camera being used for making blue prints which are consequently composed of blue lines on white paper, and these are pasted upon card-boards 13½ by 15½, and varnished for shop use; the margin between the edges of the card-board and edge of blue print being just sufficient so that the thumbs of the men who handle them will not quite reach the print. F. J. M.

Patterns for Molding Columns and Rolls.

A method that I use for stopping off building columns and drums, such as small hoisting drums, line rolls for saw-mills, etc., may interest some of your readers, so I will try to describe it with the aid of some sketches. I will describe the process for the drum or roll first. Fig. 1 shows a pattern for a hoisting drum that might be used on a crane. The diameter of the body *B* is 12 inches and the length 24 inches, besides the smaller point on left side. The larger point *E* has the flange made onto it, and only the extreme rounded edge projects beyond it. This part *E* is adjustable along the body *B* and is fastened wherever the case requires. The pattern is split on the line *X Y*.

The core box for this is shown in Fig. 2, half of the box being cut away to show the hubs and spokes. These latter are attached to a semi-cylindrical piece *A* which is to leave a place in the core for a shaft that may be cast in the drum or roll, or for a small round core to be placed to make the hole in hubs *H H*. The body of the box is the same size as the small point in Fig. 1, while the pattern at *E* is larger and the same diameter and length as the point *E* in Fig. 1. An adjustable partition *P* is set so that the total length of the core will correspond to the length *l* on the pattern in Fig. 1. I have shown the core box arranged for four spokes in each end of the drum. When the core is rammed up the hubs and spokes are withdrawn together with the piece *A*, the vertical spokes separating at a point *L*. In adjusting the core box the partition *P* is simply placed so that the total length is right, and then the hubs and spokes moved on *A*, so that the hubs project beyond the ends of the drum the required distance. The hubs may be changed to give the required length and

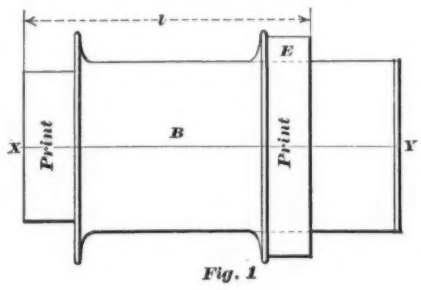


Fig. 1

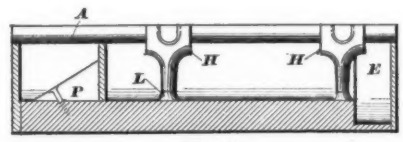


Fig. 2

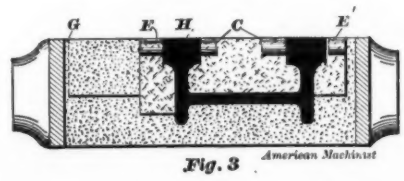


Fig. 3

diameter the same as on a pulley center. The part *A* remains the same, provided you do not cast the shaft in the drum, for chamber cores may be placed in the large core to make the holes in the hubs as large as necessary.

In Fig. 3 I have shown a section of the drag of the mold in the same way that I have shown a section of the core box. The flask must be long enough to take in the entire pattern, and would be from *G* to *E'*. The large part of the core is at *B* and completely fills or stops off that portion of the mold. I have shown it filled in between the end of the core and the end of the flask, *i. e.*, from *E* to *G*, but this is frequently unnecessary; small cores are shown set at *C*.

I first used this plan on a 6-inch building column by making the pattern a straight cylindrical piece. Then placing the enlargement at the bottom of the column, six or eight inches from the end of the pattern, the capital was made adjustable along the body of the pattern. Then if ¾ inch metal was wanted, I used a 4½-inch core box enlarged at one end to 6 inches, and 6 or 8 inches long. If the cores are swept up on a barrel the sweep is made to correspond. In the case of the core box I have usually made the length of the box equal to one-half the extreme length of the pattern.

Harvey, Ill. A. L. BOWEN.

At this writing an extensive strike is on in England among the shoe factory operatives, caused by an attempt to introduce a new American machine which will result in an economy of labor. We cannot in this instance be thankful that we "are not as other men," because similar difficulties have occurred here, and the famous Homestead war was brought on by an effort to prevent those who had paid for improved machinery from reaping any benefit from it; aggravated by lack of tact and a refusal to consider workmen as sentient beings, amenable to reason and to force of public opinion.

A correspondent sends us a newspaper item in which lightning is assigned as the cause of the explosion of a locomotive boiler, as a thunder storm prevailed at the time. This we believe is a new theory as to boiler explosions, and it is probable that a locomotive can be struck by lightning without receiving the least injury, and that they are frequently struck without anybody being the wiser. Any large mass of metal such as a locomotive can receive and transmit to the ground, without inconvenience, a charge of electricity which would be destructive to a conductor of less capacity, such as a house, a tree, or a man, for instance, and it is probable that locomotives have received and transmitted such charges many times while running without the engine men knowing anything of it.

A trial of the new electric-lighting system for the cars of the Brooklyn Bridge indicates that the entire system will be in successful operation within a few days.

NEW CATALOGS.

The G. A. Gray Co., Cincinnati, Ohio, issue a small pamphlet illustrating and briefly describing the planers made by them. It contains tables of sizes and telegraph code.

Messrs. Gaar, Scott & Co., Richmond, Ind., send an illustrated catalog of traction and other forms of farm and saw-mill engines built by them, also threshing machines, straw stackers, horse-powers, etc.

The Buffalo Forge Co., Buffalo, N. Y., issue a small pamphlet devoted particularly to the illustration and description of blacksmiths' blowers and other tools made by them, especially for blacksmiths.

Orr & Sembower, Reading, Pa., send us a copy of "Catalog J," in which are described and illustrated vertical, horizontal, marine, and hoisting engines and vertical and horizontal boilers. Tables of sizes and other information are given. It is 3½"x6".

D. Van Nostrand Co., 23 Murray street, New York, send us a catalog of publications on steam, steam engines, machinery, mechanics and mechanical engineering. It contains a very full list of such works, published both by this house and by others, and will be found a convenience for buyers of such publications. It is 6"x9¼".

The Standard Mfg. Co., Holyoke, Mass., send us an illustrated and descriptive catalog of grinding and polishing machinery of various kinds, including surface grinders, swing frame grinders, tool grinders, cup wheel surfacers, automatic shear plate and knife grinders, and other special forms of grinding machinery, in addition to the ordinary grinding and polishing frames. The catalog is standard size, 6"x9".

We have received from H. E. Collins & Co., Bank of Commerce Building, Pittsburgh, Pa., a catalog illustrating and describing the Cahall vertical water tube boiler. This catalog starts out with a statement quoted from the late Mr. Geo. H. Babcock, giving his opinion of the requirements of a perfect steam boiler. It then goes on to show by text and illustrations how the Cahall boiler fulfills these requirements. It is a well gotten up catalog, and is standard size (6"x9").

The Hayden & Derby Mfg. Co., 111 Liberty street, New York, publish a book entitled, "Practical Information About Injectors." It contains some general hints as to what comprises a perfect injector, and gives full information as to the range of automatic types, with detailed tables of capacity under various steam pressures and lifts. Similar information is given regarding other forms of injectors, and it is a book which should hardly fail to interest those who have to do with these instruments. The company named informs us that they will take pleasure in forwarding a copy to any of our readers who apply for them. This pamphlet was perhaps intended to be standard size (6"x9"); it measures 5¾"x8¾".

MANUFACTURING

The Eaton Iron and Steel Works will erect a large iron and steel plant at Eaton, Ind.

The Whittier Cotton-mills, of Lowell, Mass., is to erect a mill at Carrollton, Ga., at a cost of $194,000.

It is proposed to build a new cotton-mill at La Fayette, Ala. The East Alabama Land Agency is interested.

The Courtland Machine Co., of Baltimore, Md., has been organized by John W. D. Maier and Ferdinand C. Dugan.

The Metropolitan Electric Co., at Reading, Pa., have placed the contract for their new power house with the Berlin Iron Bridge Co., of East Berlin, Conn.

The Emmett Steel Company, of Greensburg, Pa., which was recently organized, will receive bids for the construction of a plant and for the necessary machinery.

It is said that works are to be built at Newport, Ky., to manufacture corundum wheels. J. A. Andrews, of Newport, Ky., is interested. Its capital is $50,000.

The Commissioners of Laporte County have granted a franchise for an electric railway between Laporte and Michigan City, Ind. The distance is 12 miles.

A company has been organized here to build an electric road from Turners Falls to Lake Pleasant and Millers Falls, Mass., a distance of five miles, at a cost estimated at $80,000.

The new machine shop of the Carnegie Steel Company, at Homestead, Pa., will be 150x250 feet, and will be constructed of fire brick. The plant will be equipped with electric cranes throughout.

The Kelly & Jones Company, of Greensburg, Pa., have made plans for the construction of a large new addition to their plant. It will be 200x40 feet. Work will be commenced about May 1st.

Mr. John Becker, of Fitchburg, Mass., who manufactures a high-speed vertical milling machine, informs us that he is now quite rushed with orders, is working his shop at full capacity, 14 hours per day.

The Berlin Iron Bridge Co., of East Berlin, Conn., are building a large warehouse in New York City for James Everard. The building will be 120 feet square, 12 stories high, with a steel frame, and will be entirely fireproof.

The Birmingham Rolling Mill Co., of Birmingham, Ala., will put in a complete Bessemer steel plant and machine shop. The Lodge & Davis Machine Tool Co., of Cincinnati, have sold the complete machine shop equipment.

The machine shop of W. D. Troutner, Pittsfield, Ill., was burned on the 1st of March, destroying the entire building. It will be rebuilt of brick, fireproof, and is to be completed by 1st of May. The new shop will be refitted with new tools.

A syndicate of New York and Atlantic City (N. J.) capitalists have formed a company which is to be capitalized at $4,000,000 to build an electric railroad from New York City to Atlantic City, N. J. It is proposed to have the road in operation next summer.

The Lodge & Davis Machine Tool Co. opened March 20th a branch store at 720 North Second street, St. Louis. The store will be under the management of Mr. J. W. Wright, formerly of their Chicago store. They will carry a full line of their machine tools.

It is proposed to build a road from Newcastle to Meeker, Colorado, a distance of fifty miles. The capital stock of the company is $300,000. The parties interested are: W. F. Seagarder, of Craig, Col.; J. W. Hughes & Co., A. C. Moulton, P. F. Welsh, L. W. Walbridge, of Meeker, Col.; J. Baer, of Leadville, Col.; O. T. and A. C. Drum, E. Marshall and Messrs. Kennison and McBeth, of Garden City, Kansas.

The Yale & Towne Mfg. Co., 280 Broadway, New York, announce that the recent transfer of their crane business has given rise to some misunderstanding, it being assumed by some that they had also disposed of their business and interests relating to chain tackle blocks. This, they say, is a mistake and that on the contrary they have added to their facilities for the manufacture of these blocks, and are making them in three distinct types.

A dispatch from Buffalo, dated March 26th, says: The New York Central Railroad has decided to change its motive power on the Niagara Falls branch from steam to electricity, and the trolley system will be used. Orders have been issued to begin making the changes at once, and every effort will be made to have the road in working condition for the summer excursion travel. It is supposed the power will be furnished by the Niagara Falls Power Company.

The Lodge & Davis Machine Tool Co., of Cincinnati, Ohio, have opened a branch store at St. Louis, No. 720 N. Second street, where they will carry a large stock of their well-known lathes, planers, milling machines, and other standard tools. J. W. Wright, for many years connected with the works at Cincinnati, and later with the Chicago branch, will manage the St. Louis business. Heretofore the company have been represented in St. Louis by a commission agent only.

During March, the Rice & Sargent Engine Co., of Providence, R. I., has received three orders for steam engines. One is a tandem-compound of 300 horse-power, with cylinders 14 and 26 inches and a 42-inch stroke, independent condenser, to run at 100 revolutions a minute in the Pembroke Mills, Suncook, N. H. The Lawrence, Mass., Lumber Company has ordered a 200 horse-power engine, 20x42, 80 revolutions, and the Oakdale Manufacturing Company, of Providence, R. I., a 75 horse-power engine, 12x30, 110 revolutions.

Machinists' Supplies and Iron.

New York, March 30, 1895.

Iron—American Pig: We quote standard brands, $12 to $12.50 for No. 1; $11 to $12 for No. 2, and $10.50 to $11 for No. 2 Plain. Southern brands, $11.25 to $11.50 for No. 1; $10.25 to $11 for No. 2; $10 to $10.50 for No. 3; $10.50 to $10.75 for No. 1 soft; $10 to $10.75 for No. 2 soft; and Foundry No. 4, $9.50 to $10.

Antimony—The prices are weak on account of lively competition, but a better demand is reported. We quote L. X., 8½c. to 8¾c.; Cookson's, 8¼c. to 8⅜c.; Hallett's, 7.10c. to 7.15c, and U. S. French Star, 7⅞c.

Lard Oil—Prime City we quote at 54c.

Copper—The tendency is towards an advance in prices, large export sales of Lake Copper are reported, which have relieved the market. The large companies are now asking 9½c. for Lake Copper, and offers at previous low prices are not made. Casting Copper is held at 9c. to 9⅛c.

Lead—The market is quiet and steady; producers do not care to sell at previous low prices, and demand 3.15c. for New York delivery.

Spelter—The market is somewhat firmer at 3.25c. to 3.30c. for New York delivery.

Tin—The demand by consumers has somewhat increased and prices have advanced. For New York prompt delivery 14c. net cash is asked.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Agents traveling and local to sell steam spec's; good commission. Mfr., 1115 State St, Erie, Pa.

Competent mech'l draftsman and designer, tech. graduate, wants position. Box 149, Am. Mach.

Pos. wanted as draftsm'n & designer, young man 28; tech. educa'n; shop prac. Box 154, Am. Mach.

Foreman patternmaker who knows his business, and how to get work done, desires engagement, immediately. Box 140, American Machinist.

Exp'd chief draftsman desires situation; latest practice in hoisting, mining, steam, and gen. machinery, estimat'g & com'l exp. Box 145, Am. Mach.

Wanted—Pos. as supt. or forem'n of mach'e shop; I have valuable mech'l patent which will bring good business; good refs. W., 236 Charles St., Prov., R. I.

Mech. draftsman and rapid tracer (22), tech. educat'n, 6 years shop, drawing office exp., desires pos.; eng's, print'g mach'y pref'd; refs. Box 150, Am. Mach.

Wanted—Draftsman on locomotive and car work; give age, salary required, and references. Address Box 151, American Machinist.

Wanted—Pos. as foreman by 1st-class tool maker on machine tools & gen'l mach'y; desires a change; 18 years' exp.; A1 refs. Foreman, care Am. Mach.

Marine engineer and designer, with 20 years' exp. in marine engineering, desires to change; situation as supt. or chief draftsman; competent to assume complete charge; refs. Marine Engineer, Am. Mach.

Correspondence solicited with parties wishing machinery designed and perfected by a practical mechanic and draftsman; best of reference given. Box 148, Am. Machinist.

Desires a change, a first-class all-round machinist; had considerable exp., in running and repairing Corliss engines, pumps, etc.; American; strictly temp'e; 32 yrs. old; 14 yrs. exp. Box 152, Am. Mach.

Wanted—Two or three good machinists to work in shop, building hoisting and haulage engines; only first-class men wanted; a steady job and standard wages will be given suitable mechanics. Apply or address Kenney & Co., Scottdale, Pa.

Mech. engineer, expert draftsman and good mechanic, long exp. in designing and superintending construction of all kinds of mach'y, and handling of help to advantage, wants engagement in New York or vicinity. Address Box 146, Am. Mach.

Foreman patternmaker wants position; 15 years present position, first-class man, accustomed to all kinds of work; best of reference; reason for leaving, retiring from business; city or country. Address Box 147, Am. Machinist.

A thorough practical machinist and draftsman, 15 years' experience, has been in business in New York City for a number of years for himself, wishes a position as foreman in some good shop. W. J. H., American Machinist.

A practical man of energy and push desires a change of location. Eight years' experience with large electrical company. Would like to correspond with parties in need of a hustling superintendent. Address Energy, care Am. Machinist.

Mechanical engineer, age 30, thoroughly versed in the theory, practice and design of steam and refrigerating mach'y, desires sit. as eng'r or designer, competent to assume complete charge and responsibility of any work in these branches; strictly highest class refs. A. M. B., Am. Mach.

A young engineer, designer and constructor, now with one of the leading engineering establishments of the country, will negotiate with principals for a change as M. E. or chief draftsman; thorough practical and technical training; 10 years' practical contact and varied experience with the leading concerns, thoroughly versed in American and English engineering practice; highest references. Address Box 153, care American Machinist.

Wanted—A master machinist as foreman of a marine machine shop; he must have had a large experience and practice in shops engaged in building and repairing marine engines; must be proficient in drawing and accustomed and competent to make estimates on such work; pref. would be given to a person between the ages of 30 and 45; applicants may address Master, care of Amer. Mach., giving full reply to above with refs. if practicable.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Read Randall's New Advertisement, page 271.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Bicycle Repair Outfit. Send 6 cents postage for full illus. catalog. Frasse, 17 Warren St., New York.

Wanted—A purchaser for a good key-seater, by Mitts & Merrill, 913 Tilden Street, Saginaw, Mich.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden St., Saginaw, Mich.

Best and cheapest Bolt Header made by C. H. Baush & Sons, Holyoke, Mass.

For rent in first class locality, machine shop and foundry. J. N. Cooper, Elmira, N. Y.

Wanted—To correspond with any one in need of a first-class key-seater. Address Mitts & Merrill, No. 913 Tilden Street, Saginaw, Mich.

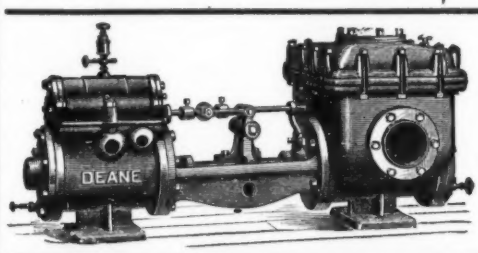
Partnership wanted in a paying established business by an experienced and successful mechanical engineer and manager who can invest in ready cash and devote his entire time to the business; no objection to joining with a good business man with corresponding capital in pushing a safe and profitable enterprise. Address with full particulars, Engineering Partner, American Machinist.

REDUCING VALVES

For reducing and maintaining an even steam, air or water pressure. These valves have been on the market for years, and are used by all the best and largest steam plants of the world.

MASON REGULATOR CO., Boston, Mass.

Western Office: 1649 Monadnock Building, CHICAGO, ILL.



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Buffalo FAN SYSTEM OF HEATING & VENTILATING ALL LARGE BUILDINGS · BY A FORCED CIRCULATION OF WARM AIR. · BUFFALO · FORGE · CO · BUFFALO, N.Y.

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The Best Steel you can get anywhere for Cold Chisels.

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Ready Made Brass Gears.
Gears Made to Order.
Gear Cutting.
1895 Gear Book, Free.
Treatise on Gears, $1.00.
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and 125 South 11th St.,
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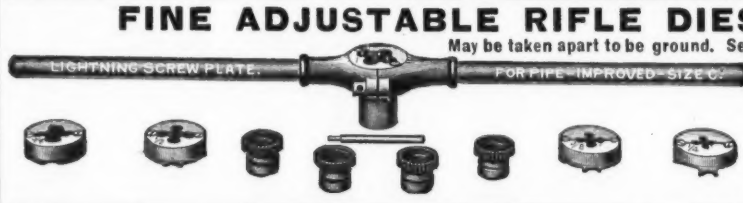
FINE ADJUSTABLE RIFLE DIES.

May be taken apart to be ground. Send for catalogue.



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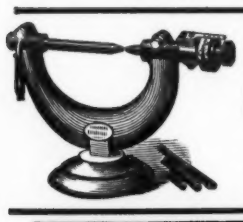

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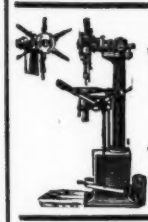

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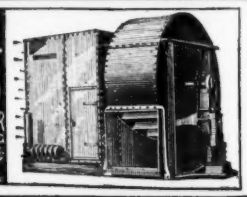

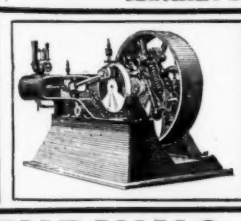

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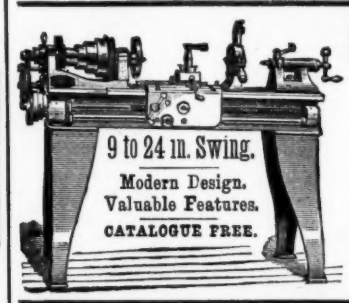

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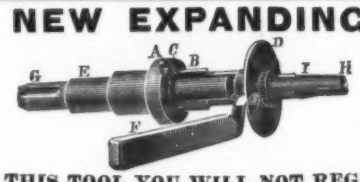

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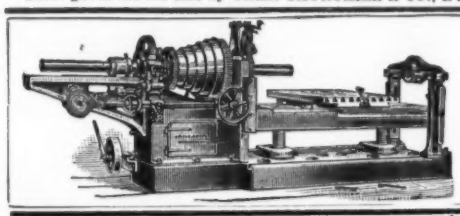

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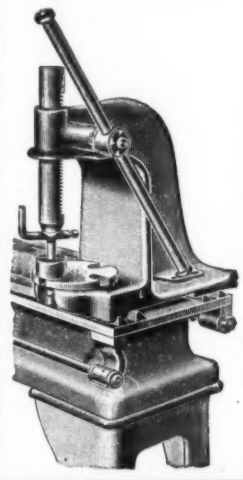

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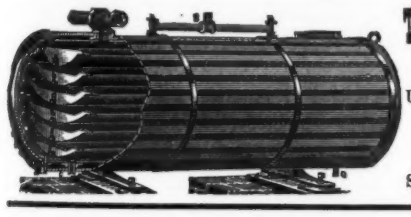

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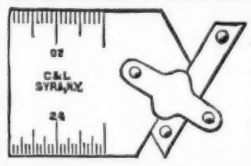

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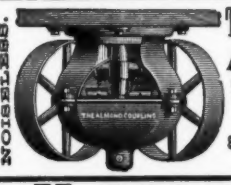

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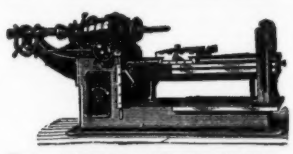

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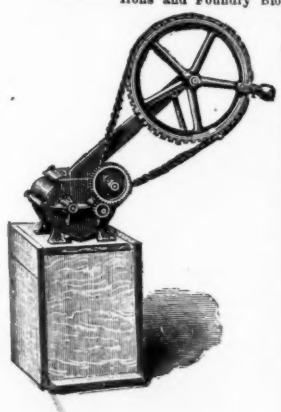

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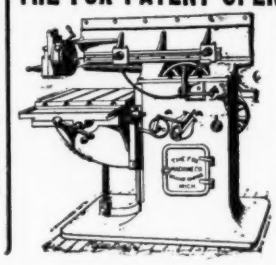

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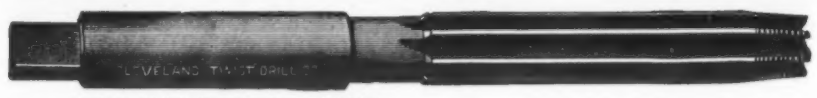

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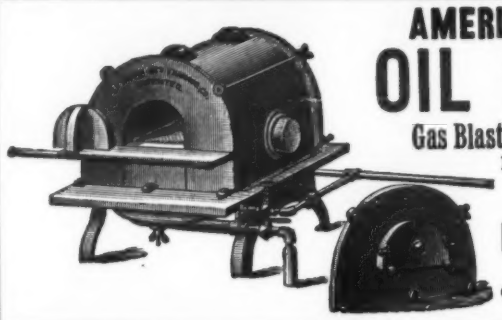

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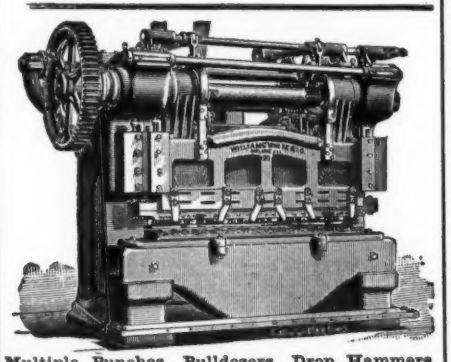

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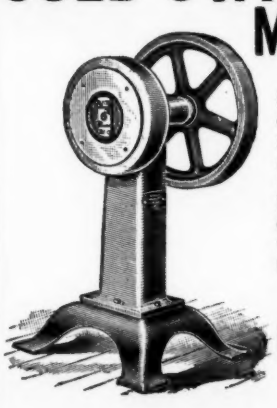

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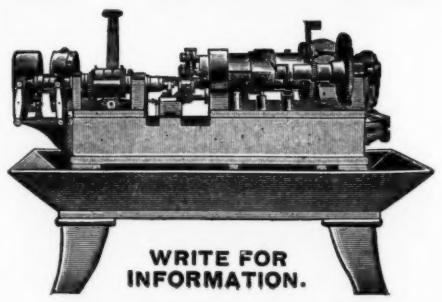

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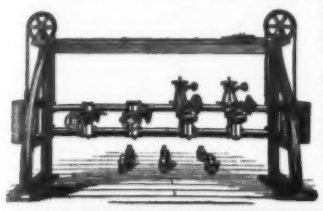

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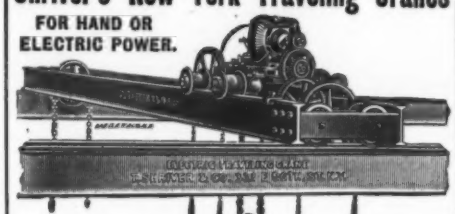

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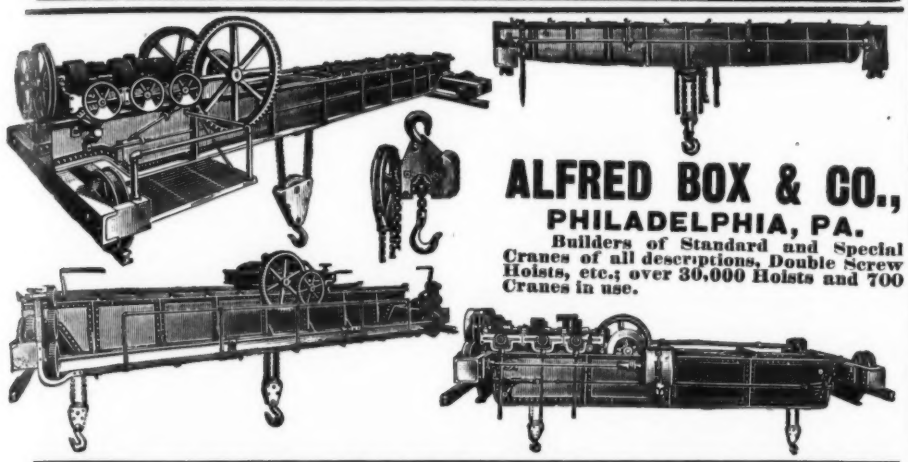

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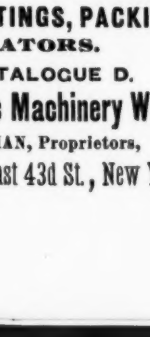

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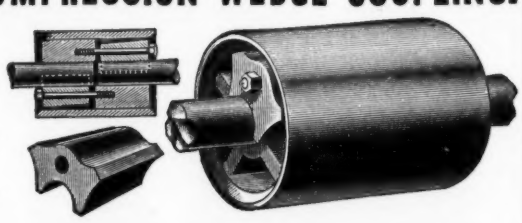

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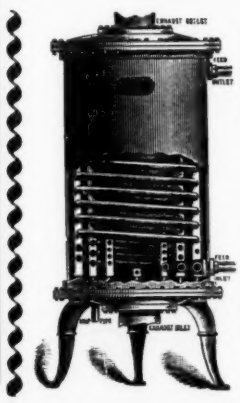

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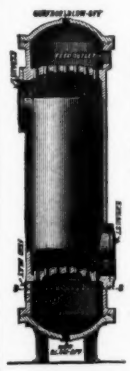

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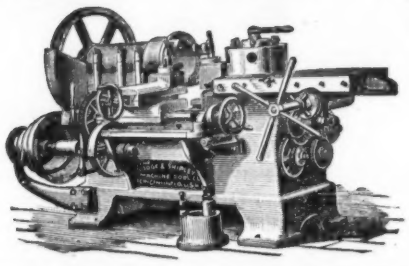

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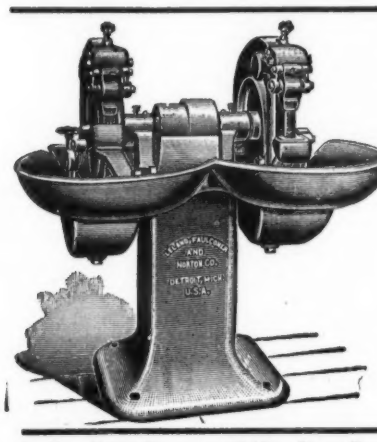

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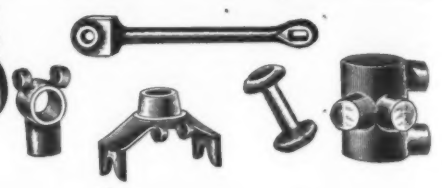

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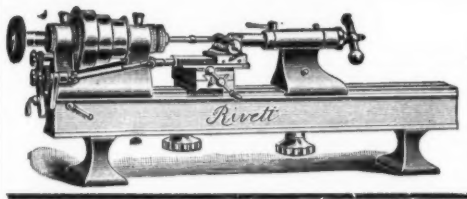

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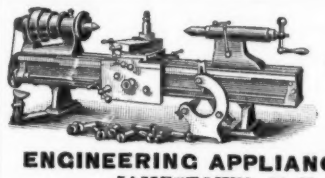

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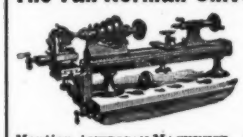

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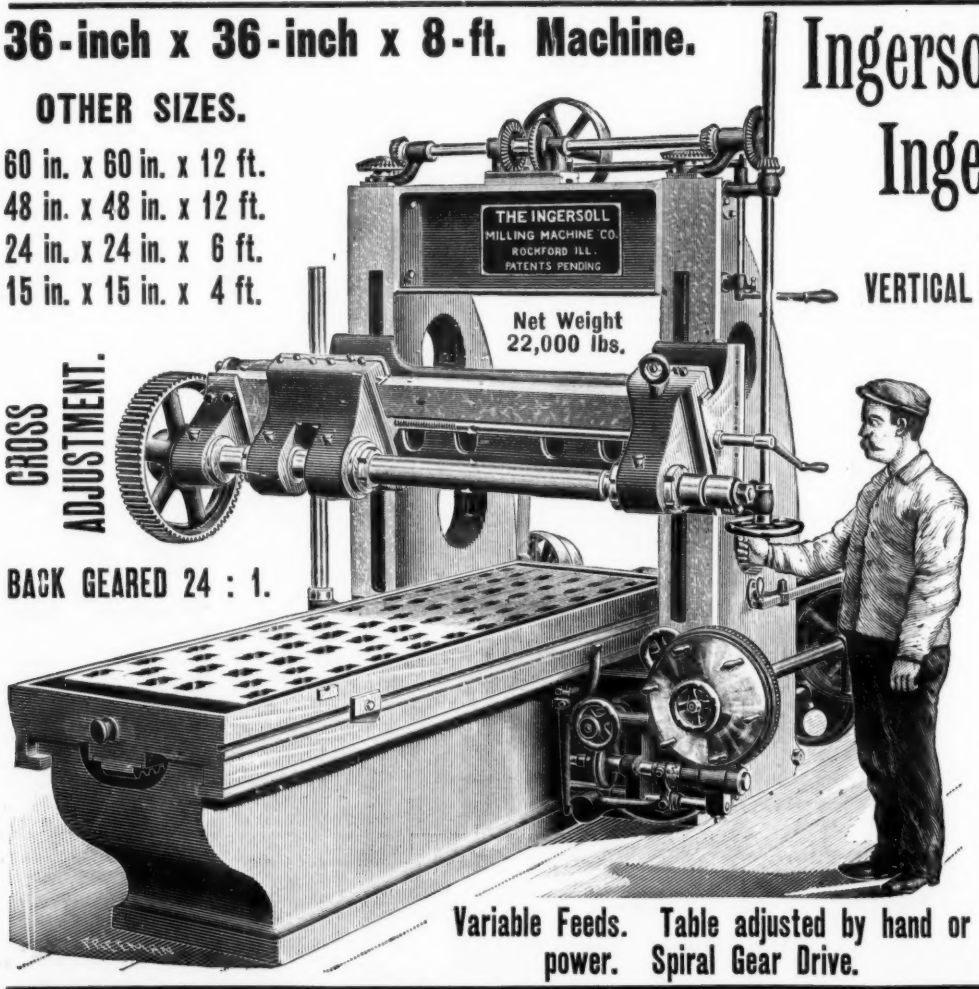

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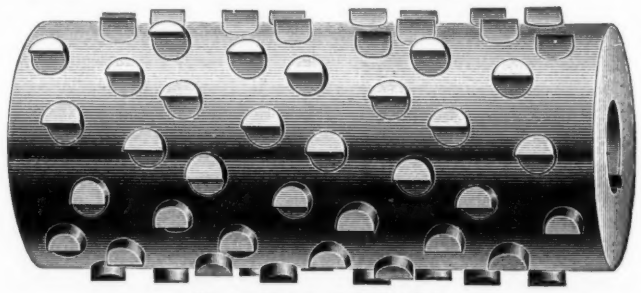

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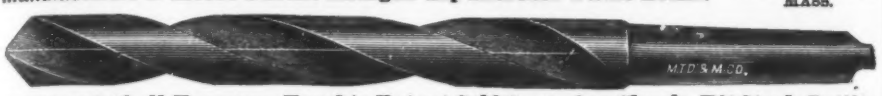

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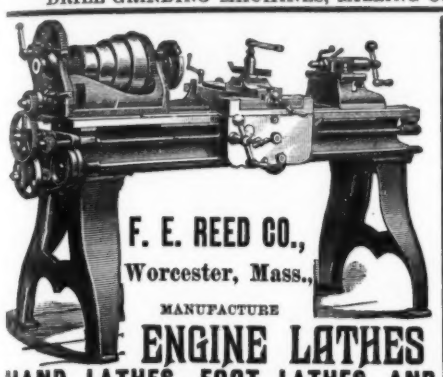

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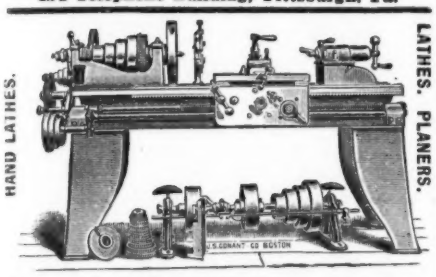

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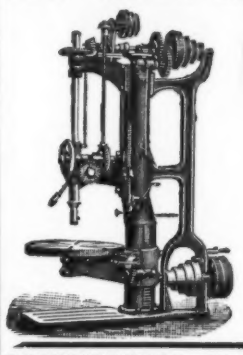

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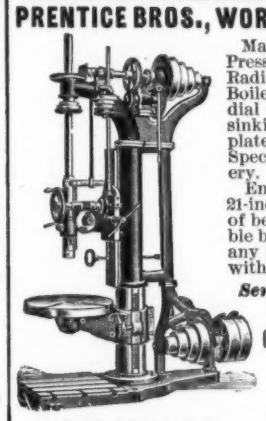

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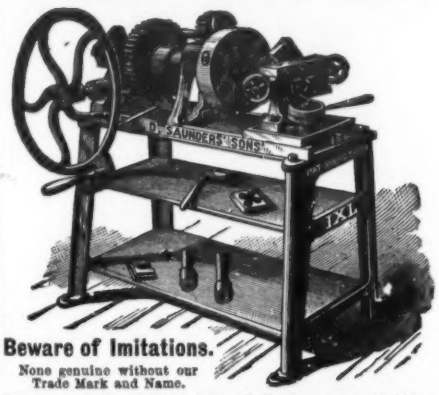

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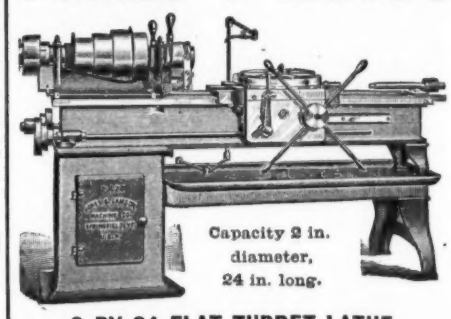

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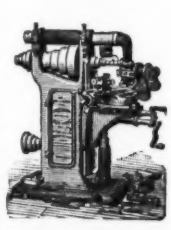

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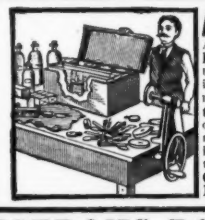

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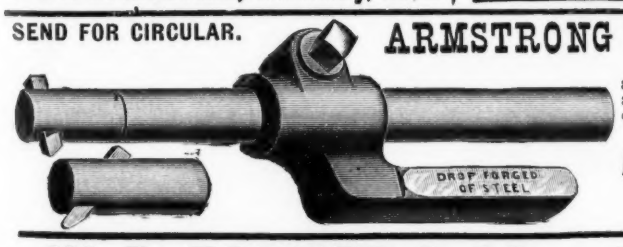

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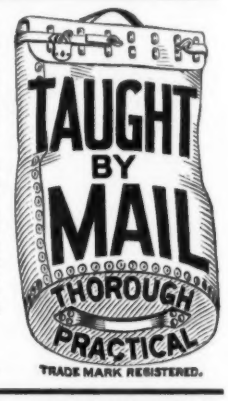

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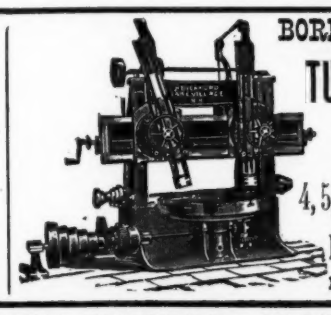

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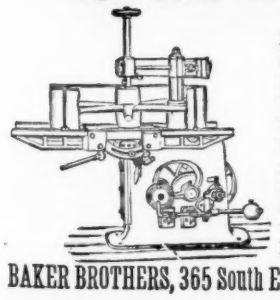

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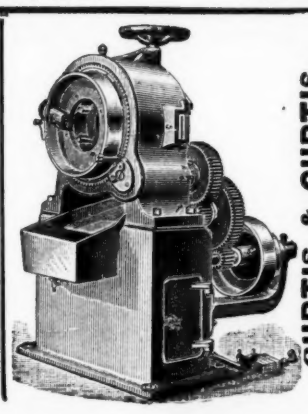

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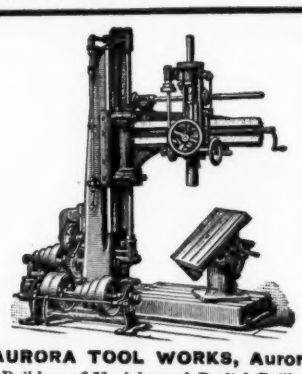

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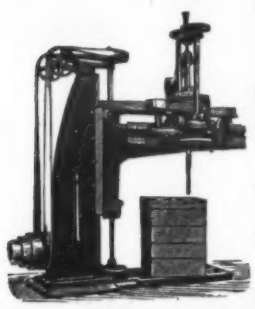

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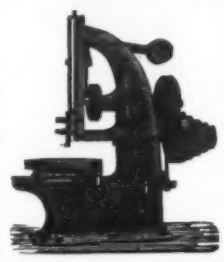

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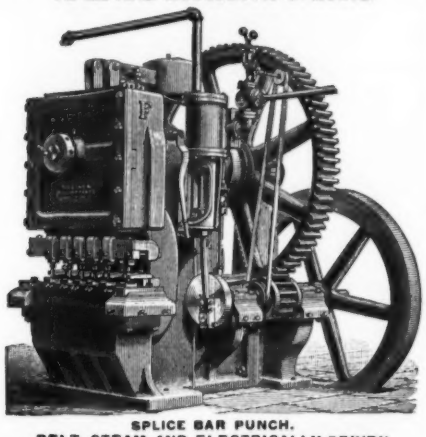

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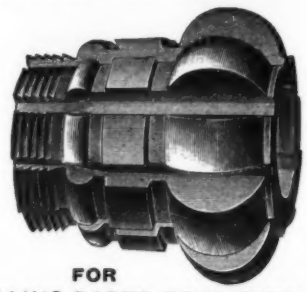

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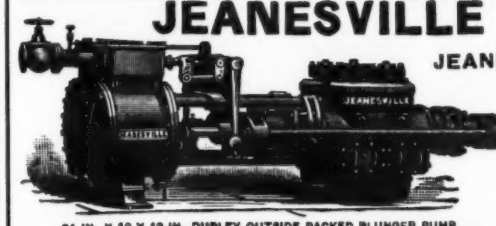

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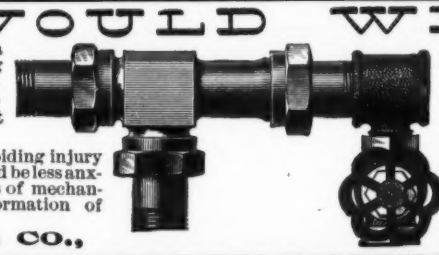

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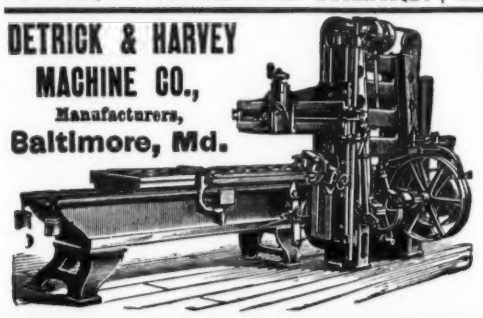

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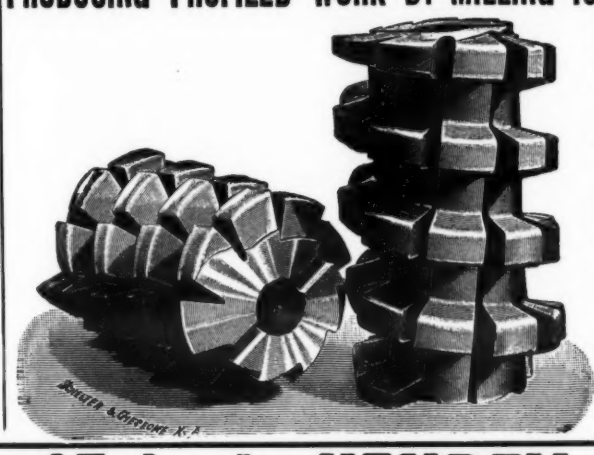

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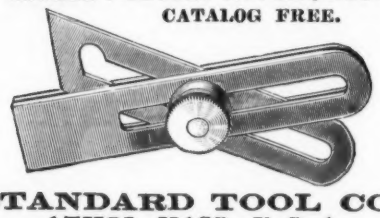

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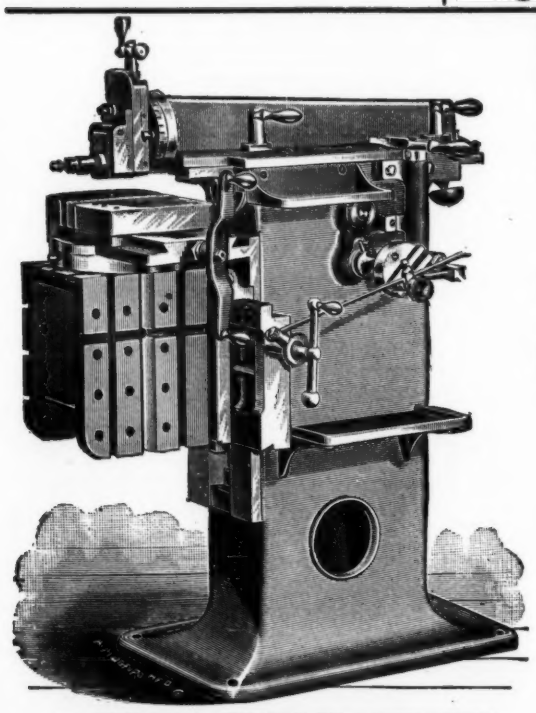

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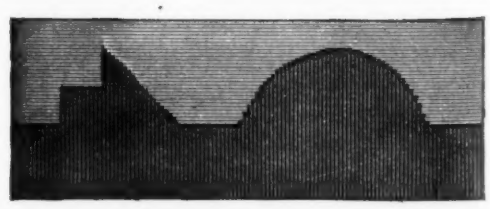

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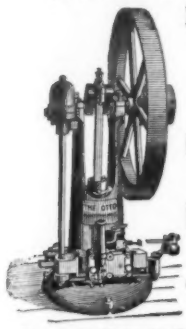

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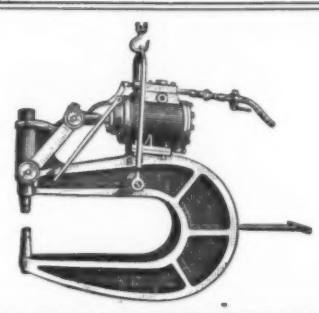

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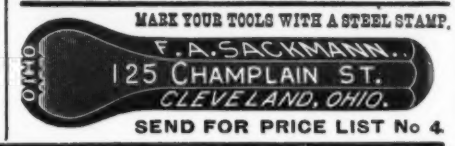

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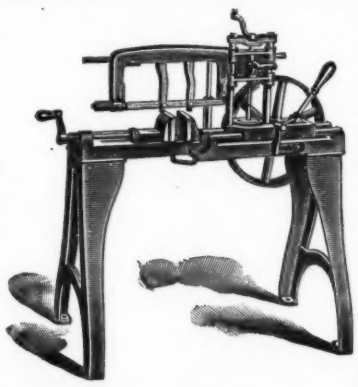

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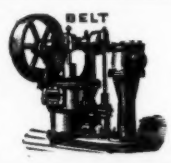

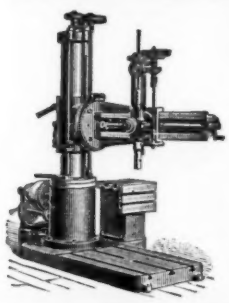

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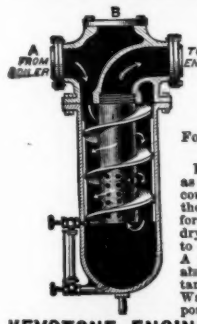

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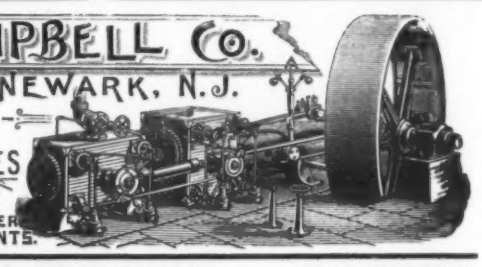

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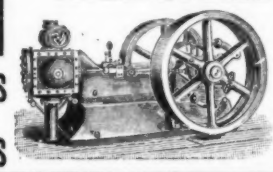

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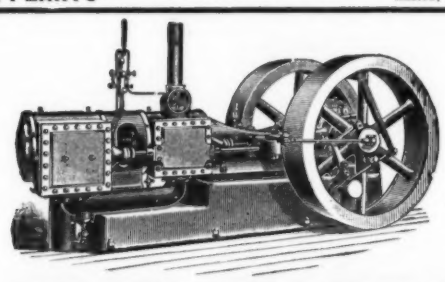

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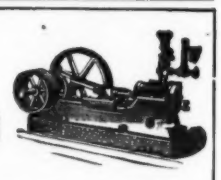

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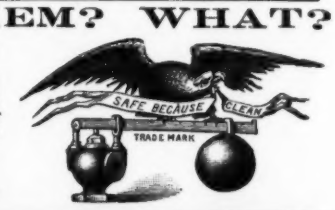

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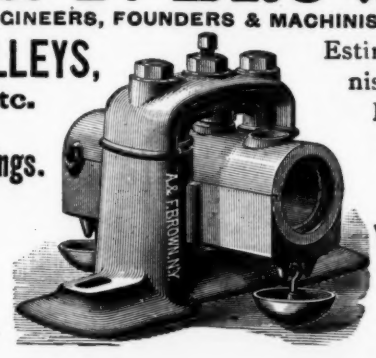

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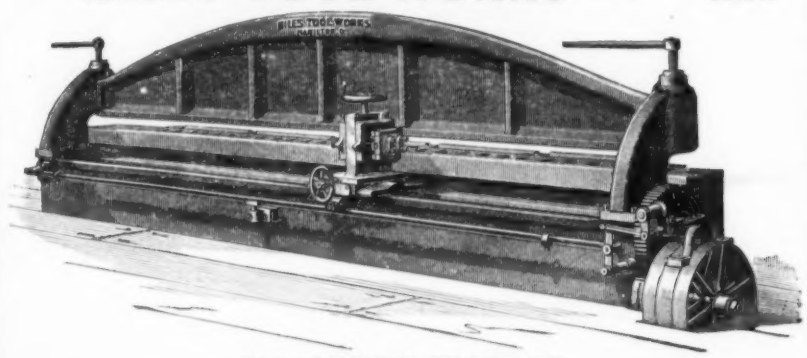

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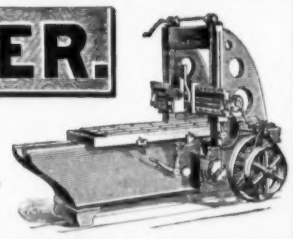

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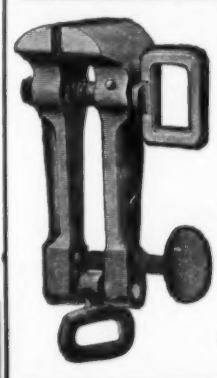

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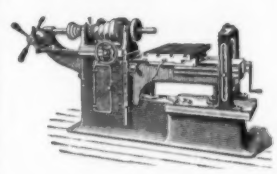

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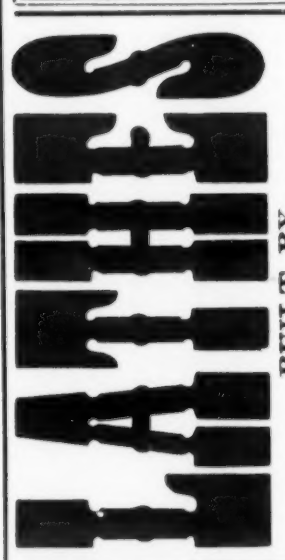

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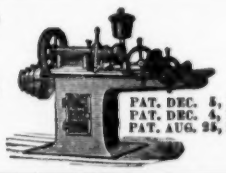

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